PREVENTING PREGNANCY, PROTECTING HEALTH:

A New Look at Birth Control Choices in the United States

THE ALAN GUTTMACHER INSTITUTE

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By Susan Harlap, Kathryn Kost and Jacqueline Darroch Forrest

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Introduction: A New Look

Choosing a contraceptive is a complex process; there are many factors that couples need to consider in making their decision. In an attempt to help make their choice an informed one, this book examines the health consequences of birth control methods used in the United States today. It examines the most up-to-date information available on how the methods affect the likelihood of avoiding an unintended pregnancy, of preventing infertility and of maintaining good health.

Contraceptive Use in the United States

CHAPTER 2 ***Sexual Activity and Unintended Pregnancy***

The majority of sexually active women in the United States are trying to postpone childbearing or prevent it altogether, but many are not successful. More than half of pregnancies that occur each year are unintended.

CHAPTER 3 ***Contraceptive Methods***

The contraceptive methods currently available in the United States vary widely in how they work to prevent pregnancy and in what they require of the users.

CHAPTER 4 ***Current Use of Contraceptives***

The choice of a contraceptive method is strongly affected by a woman's or couple's childbearing plans. Among women who intend to have a child in the future, the most popular methods are oral contraceptives and the condom, while among women who do not intend to have any more children, their own or their partner's sterilization is the preferred method.

CHAPTER 5 ***Pregnancies Occurring During Contraceptive Use***

Some contraceptive methods are associated with higher rates of unintended pregnancies than are others. Couples using a method that requires interruption of or abstinence from intercourse are more likely than others to experience a contraceptive failure.

Future Fertility

CHAPTER 6 ***Sexually Transmitted Diseases***

Most American men and women have more than one sexual partner during their lives. Some, especially young people, have several partners over a relatively short period of time. One potential consequence of having a new partner is acquiring a sexually transmitted disease (STD); such diseases are highly prevalent in the United States. Barrier and spermicide methods can help protect against STDs, but they must be used consistently to be effective.

CHAPTER 7 ***Upper Genital Tract Infection***

Pelvic inflammatory disease (PID), an upper genital tract infection, occurs annually in about one percent of sexually active American women

and is usually a consequence of STD. Upper genital tract infection can also develop after childbirth or abortion. Women in mutually monogamous relationships are unlikely to contract STDs and are therefore unlikely to experience an upper genital tract infection. Women who are not in mutually monogamous relationships are at high risk for STDs. Among such women, using barrier and spermicide methods and oral contraceptives will prevent large numbers of upper genital tract infections, while using periodic abstinence, the IUD or no method will add substantially to the risk of upper genital tract infection.

CHAPTER 8 ***Ectopic Pregnancy***

More than one percent of pregnancies are ectopic; many are a consequence of a previous tubal infection. Although pregnancies resulting from the failure of some contraceptives are more likely to be ectopic than are those resulting from the failure of others, use of any birth control method reduces the risk of ectopic pregnancy relative to that associated with use of no method. This benefit is most pronounced among women in relationships that are not mutually monogamous.

CHAPTER 9 ***Tubal Infertility***

Upper genital tract infection and ectopic pregnancy can lead to tubal infertility; therefore, birth control methods and other factors that change the risk of infection or ectopic pregnancy can affect the risk of infertility. Women in relationships that are not mutually monogamous or in which one of the partners carries an STD are at greatly increased risk of tubal infertility, especially if they use the IUD, periodic abstinence or no method. Barrier and spermicide methods will help to preserve these women's potential to bear children in the future. Women in mutually monogamous relationships in which neither partner has an STD have a low risk of tubal infertility; contraceptive choices will have little influence on their future fertility.

Health Effects of Contraception

CHAPTER 10 ***Cancer***

Use of some birth control methods can benefit a woman's health by reducing the incidence of certain cancers, most of which would occur in later life, long after the need for contraception has passed. Barrier and spermicide contraceptives reduce the chance of developing cancer of the cervix; the longer they are used, the lower the risk. Oral contraceptives reduce women's risk of ovarian and endometrial cancer; this benefit affects women soon after starting pill use, becomes stronger with greater duration of use and persists for many years after use is discontinued.

The relationship of oral contraceptives to breast cancer is not yet completely clear. Through age 54, breast cancer is equally common among women who have and have not ever used the pill. Some studies

have suggested, however, that women who used the pill for prolonged periods in their teens or early 20s are more likely than those who did not to be diagnosed with breast cancer in their 30s and early 40s. Evidence also suggests that as such women become older, they may be less likely to develop breast cancer than women who never used the pill.

CHAPTER 11 ***Cardiovascular Disease***

Smoking is a major cause of heart and circulatory diseases. Birth control pills add to a woman's risk of some types of cardiovascular disease, but not other types. The overall added risk for users of oral contraceptives is very low in young women and nonsmokers who are healthy and who have no predisposing factors for cardiovascular disease.

Comparing Health Effects of Contraceptive Methods and Contraceptive Failure

CHAPTER 12 ***Complications Requiring Hospitalization***

In addition to preventing pregnancy, birth control methods can influence health through their side effects, either beneficial or harmful. These side effects may occur because of direct effects of the method or indirectly, as a result of pregnancies due to contraceptive failure. When side effects requiring hospitalization are considered, IUDs, oral contraceptives and vasectomy offer health benefits that most strongly outweigh the risks associated with their use.

CHAPTER 13 ***Mortality***

Deaths associated with contraceptive use are relatively rare in the United States. Rates vary according to both the likelihood of pregnancy while the method is being used and any risks attendant to the method itself. The probability of death resulting from use of a contraceptive needs to be balanced against the probability of death from pregnancy and childbirth if no method is used—at all ages, contraceptive use prevents deaths, compared with using no method. In addition, oral contraceptives and barrier and spermicide methods avert future deaths by their protection against cancer.

CHAPTER 14 ***Preventing Pregnancy, Protecting Health***

Contraceptives differ in their implications for preventing pregnancy, preserving fertility and protecting health. In addition, individuals' behaviors can influence a contraceptive method's effects. Women and men should be aware of the implications of their behaviors and tailor their contraceptive choice to meet their own concerns and goals. But the paramount message is clear: Couples who use any method are far more likely than those who use no method to prevent pregnancy, preserve fertility and protect health.

Contraceptive Use in the United States

CHAPTER 2 *Sexual Activity and Unintended Pregnancy*

2.1 Two-thirds of American women aged 15–44 are at risk of unintended pregnancy—they are sexually active, are physically able to become pregnant and do not want to have a child now. 19

2.2 Nine in 10 women aged 20–44, and over half those aged 15–19, have had intercourse; most are currently sexually active. 20

2.3 While few young women are infertile, about one in five women aged 40–44 are physically unable to have a child because of illness or surgery other than contraceptive sterilization. 20

2.4 At any given time, more than one in 10 women aged 20–34 are pregnant, postpartum or seeking pregnancy. 20

2.5 Over two-thirds of all women 20–44 are at risk of unintended pregnancy. Most younger women want to have children later. The majority over the age of 30 intend to have no more children. 21

2.6 More than half of the approximately six million pregnancies in the United States each year are unintended. 21

2.7 Most pregnancies each year among women under age 25 are unintended, as are substantial proportions of pregnancies among older women. 21

2.8 Among women aged 15–34, at least one in 10 are pregnant each year; young women are the most likely to have unintended births. 22

2.9 About as many unintended pregnancies end in induced abortions as in births, except among women 35 and older, who more often choose abortions than give birth. 22

CHAPTER 4 *Current Use of Contraceptives*

4.1 Oral contraceptives and sterilization are the methods most commonly used by American couples. 30

4.2 Women at risk of unintended pregnancy who intend to have a child in the future are most likely to use oral contraceptives, or barrier or spermicide methods. 31

4.3 Women at risk of unintended pregnancy who intend not to have a child in the future are most likely to rely on sterilization. 31

4.4 In the early stages of their reproductive lives, women at risk of unintended pregnancy are likely to use oral contraceptives; most older women rely on sterilization. 32

CHAPTER 5 *Pregnancies Occurring During Contraceptive Use*

5.1 Nine in 10 women at risk of unintended pregnancy are using contraceptives; the small proportion of women who do not use a method account for over half of all unintended pregnancies. 33

5.2 Unintended pregnancies are almost as likely to result in birth as in induced abortion, whether they result from not using contraceptives or they follow contraceptive failure. 34

5.3 Pregnancy rates vary widely depending on which, if any, contraceptive a couple chooses. In addition, pregnancy rates for most contraceptives are greatly affected by how consistently and correctly the methods are used. 35

5.4 Pregnancies are most common among those aged 15–24 for both women with relatively low contraceptive failure rates and women with relatively high failure rates. 36

5.5 Women who use contraceptives will have far fewer births and abortions over the course of their reproductive lives than if they had used no method at all. 39

Future Fertility

CHAPTER 6 ***Sexually Transmitted Diseases***

6.1 More than 12 million episodes of STDs occur annually in the United States. 41

6.2 A majority of American women who have had intercourse have more than one sexual partner over their lifetime. 42

6.3 The likelihood of currently having multiple sexual partners declines with age. 42

6.4 A single act of unprotected intercourse with an infected person can transmit STDs. In the case of most STDs, women are more readily infected by men than vice versa. 43

6.5 Younger women are the ones who most frequently contract an STD; gonorrhea is one example. 44

CHAPTER 7 ***Upper Genital Tract Infection***

7.1 The younger a woman is, the more likely she is to develop PID. 45

7.2 Women in mutually monogamous relationships are unlikely to experience upper genital tract infections; contraceptive choice has a small effect on their risk of developing such infections. Among women not in mutually monogamous relationships, birth control can greatly influence the risk of upper genital tract infection. No method, periodic abstinence and IUDs are poor choices for such women. 47

CHAPTER 8 ***Ectopic Pregnancy***

8.1 PID can lead to ectopic pregnancy; the more episodes of PID a woman has had, the more likely she is to have an ectopic pregnancy. 49

8.2 A woman who has had an ectopic pregnancy is at increased risk for future ectopic pregnancy. 49

8.3 The failure of some contraceptive methods is more likely than the failure of others to lead to ectopic pregnancy. 50

8.4 Women using no contraceptive method are the most likely to have an ectopic pregnancy. However, ectopic pregnancies are much less common among women who are at low risk for STD than they are among women who are at high risk for STD. 51

CHAPTER 9 ***Tubal Infertility***

9.1 Tubal infertility is more common among women who have had PID. 53

9.2 Tubal infertility can result from ectopic pregnancies. 53

9.3 Among women in mutually monogamous relationships, tubal infertility from infection is rare. This is true regardless of choice of contraceptive method. Among women not in mutually monogamous relationships, by contrast, tubal infertility is much more common. Barrier and spermicide methods offer these women the greatest protection. 54

Health Effects of Contraception

CHAPTER 10 ***Cancer***

10.1 About two-fifths of all cancers among women occur in the reproductive system; breast cancer is the most common. 57

10.2 Use of oral contraceptives greatly reduces the incidence of ovarian cancer; the number of cases prevented—the difference between the number among users and the number among nonusers—is greatest among older women. 59

10.3 Use of oral contraceptives reduces the risk of endometrial cancer; the number of cases prevented—the difference between the number among users and the number among nonusers—is greatest among older women. 61

10.4 Studies in three countries show that long-term pill users under age 35 are more likely to have breast cancer diagnosed than never-users of the same age. Among women 45–54, the relationship is reversed: Pill users are less likely to be diagnosed with breast cancer. 63

10.5 Women who have used oral contraceptives for a long time are less likely at most ages to be diagnosed with reproductive cancers than women who have never used the pill. The protection gained from oral contraceptive use is greatest at older ages. 65

10.6 Barrier and spermicide contraceptives reduce the risk of cervical cancer. Their effect increases with age. 67

10.7 Contraceptive methods can have different effects on various types of cancer; in general, the effects are protective. 70

10.8 Women who have ever used the pill or barrier or spermicide methods will have fewer cancers of the reproductive system diagnosed by age 55 than those who have never used those methods, but the differences will be small. Moreover, women who have ever used the pill, barrier or spermicide methods will also be slightly less likely to have cancers that will be fatal within five years after diagnosis. 72

CHAPTER 11 ***Cardiovascular Disease***

11.1 The risk of myocardial infarction varies with age, pill use and smoking. For all women the risk increases with age. Among nonsmokers oral contraceptives add very little to that risk. The risk of myocardial infarction is higher among light smokers than among nonsmokers, especially among older women, and oral contraceptive use further increases the risk. Heavy smoking increases the effects of both age and oral contraceptive use on the risk of myocardial infarction. 76

11.2 Oral contraceptive use adds little to the risk of stroke due to subarachnoid hemorrhage and death from it among nonsmokers. But light smokers greatly increase their risk if they use oral contraceptives. And heavy smokers who use oral contraceptives, especially at older ages, have even greater risks. 78

11.3 Venous thrombosis and embolism are more common than the other cardiovascular diseases, and oral contraceptive use adds to their risk. Smoking combined with oral contraceptive use increases the risk of venous thrombosis and embolism. Older women who are heavy smokers and use oral contraceptives have especially high risks of this disease; even among them, however, mortality from venous thrombosis and embolism is rare. 80

Comparing Health Effects of Contraceptive Methods and Contraceptive Failure

CHAPTER 12 ***Complications Requiring Hospitalization***

12.1 The principal health risks associated with periodic abstinence are related to its lack of protection against upper genital tract infections and to its high failure rate, which leads to more cesarean deliveries. 84

12.2 Risks of hospitalization are small for women using barrier and spermicide methods. 86

12.3 Each insertion of a copper-bearing IUD carries a low risk of perforation, but since the method can remain in place for up to six years, this risk is small compared with the benefits associated with its use. 88

12.4 Use of combined oral contraceptives prevents many more hospital admissions than it adds. 89

12.5 Complications from tubal sterilization occur only once, at the time of the operation; benefits remain for the rest of a woman's reproductive life. 91

12.6 Vasectomy is associated with even fewer complications than is tubal sterilization. 92

CHAPTER 13 ***Mortality***

13.1 Deaths associated with pregnancy and childbirth constitute only a small fraction of deaths among all U.S. women of reproductive age. 94

13.2 No matter what their outcome, pregnancies involve a risk of dying. At all ages, women having an ectopic pregnancy are by far at the greatest risk of pregnancy-related death. Pregnancies ending in birth involve higher risks at older ages. Pregnancies ending in induced abortion involve a low risk regardless of age. 95

13.3 Pregnant women choosing to give birth face a higher risk of death than those choosing abortion. Women who use a contraceptive reduce their risk of death by decreasing their risk of pregnancy. Pregnancy-related deaths are least common among women using the most effective methods. 96

13.4 Contraceptives avert deaths by preventing pregnancy and childbirth, which become riskier with age. Although hormonal methods and sterilization involve risks of death from method-related causes, even they, as well as all other methods, are safer than using no method and having a birth. 98

13.5 Contraceptive use saves lives. Women using barrier or spermicide methods or oral contraceptives have fewer deaths while using these methods than if they used no method. Contraceptive use also prevents death from another perspective: Women who have ever used barrier or spermicide methods or oral contraceptives will experience fewer deaths from cancer before age 45 than if they had never used these methods. 101

CHAPTER 14 ***Preventing Pregnancy, Protecting Health***

14.1 Contraceptives differ in their implications for preventing pregnancy, preserving fertility and protecting health; using any method will greatly improve a woman's chance of reaching her reproductive and health goals. 104

CHAPTER ONE

Introduction: A New Look

SUMMARY

Choosing a contraceptive is a complex process; there are many factors that couples need to consider in making their decision. In an attempt to help make their choice an informed one, this book examines the health consequences of birth control methods used in the United States today. It examines the most up-to-date information available on how the methods affect the likelihood of avoiding an unintended pregnancy, of preventing infertility and of maintaining good health.

Most women and men in the United States want to have children. Most, however, want to have children when they are most able to care for them and to limit the number they have. Americans, on the whole, want small families, yet they do worse than citizens of many other developed countries at preventing undesired pregnancies—they have one of the highest unintended pregnancy rates among these nations.[1] As a result, the United States also has one of the highest abortion rates and one of the highest rates of unintended births in the Western, developed world.[2] Most of those births occur before couples are ready for a child, but some occur after couples have had all the children they want.

One reason why Americans control the number and timing of pregnancies so poorly is that there are fewer contraceptive options here than in many other countries.[3] In addition, U.S. couples are more likely than those elsewhere to use the less-effective methods, and may be less likely to use effectively the methods they do choose.[4] Many factors explain this phenomenon, ranging from problems of access to medical care in the absence of a national health insurance system to cultural attitudes about sexuality and reproduction. In addition, Americans lack reliable information—or are often misinformed—about the safety and efficacy of the various methods of birth control.

Despite wanting to avoid pregnancy, many couples use no method of birth control at all for certain periods of time. The most common reason American women give for not using contraceptives is the fear of side effects and potential health problems.[5] Often sensational media coverage of research findings—rarely presented in context with more thorough, comprehensive and balanced (less attention-catching) reports—exacerbates that fear. In addition, the litigious climate of the United States frequently leads physicians, clinics and pharmaceutical companies to seek protection against malpractice and liability claims by insisting on lengthy and frightening informed consent procedures; occasional large damage settle-

ments reinforce the public's perception that contraceptives are dangerous. The decline in the use of oral contraceptives and IUDs in the 1970s is a well-documented instance of the impact the media can have on the public's perception of the risks attendant to these methods.[6]

Because media reports often emphasize dangers and risks, the public may receive a one-sided view of the health effects of birth control. Fear or confusion may lead some people to stop using their contraceptives. Many people believe that particular methods endanger health, and they assume that women could decrease their risk of developing health problems by using no method of contraception at all. Yet few realize how pregnancy and childbirth create hazards for a woman's health, as well. Potentially adverse effects of birth control must be weighed against those of unintended pregnancies that could occur if a woman were using no method or one with a high risk of failure.

If contraceptives can have undesirable side effects, they can also have side benefits in addition to and unrelated to their ability to prevent unintended pregnancies. For instance, hormonal methods can help protect against certain cancers, as well as against ovarian cysts, benign breast disease and other common conditions. Barrier and spermicide contraceptives can help prevent HIV infection and other sexually transmitted diseases (STDs), and the pelvic infections that can result from some STDs. Often women and men know of a method's potential risks but not of its possible benefits, or they learn about one method at a time rather than comparing the information available for all their options. To make the most appropriate choices, individuals and couples should take side benefits of all contraceptives into consideration when choosing a method.

A couple's contraceptive choice will affect whether they will succeed in having the number of children they want when they want them, or whether they will have to decide between continuing a pregnancy at a time they had not planned to have a child and having an abortion. Certain options will benefit a woman's health, others may affect it adversely. Unless couples are able to make fully informed comparisons of the different options, weighing any dangers against the likelihood of benefits, they may inadvertently raise, rather than lower, their likelihood of experiencing health problems. *Preventing Pregnancy, Protecting Health: A New Look at Birth Control Choices in the United States* deals with the ways in which using each contraceptive method affects women's health, as well as with the health consequences of not practicing contraception for women who are sexually active but do not want to have a child now.

Choosing a contraceptive is a complex process when all factors are considered. While the number of contraceptives available in the United States may seem so small that deciding should be easy, methods differ in their implications for controlling pregnancies, preserving future fertility and safeguarding health.

Whereas persons suffering from illness are often willing to assume the risk of taking a drug that may have an adverse effect or undergoing an operation in the hope of improving their health, those wishing to prevent pregnancy do not want to risk harming

themselves through contraceptive use. In addition, unlike most treatments undergone or prescription drugs taken by people of childbearing age, contraceptives are frequently used for many years. We therefore demand greater safety—both short-term and long-term—from modern birth control methods than we do from procedures or drugs used to treat disease.

No individual choosing a contraceptive can be certain that she will not experience an illness while using it. No one can be sure that a birth control method will prevent a particular disease. However, probabilities for improving health and harming health can be determined for large groups of people. Various methods affect those with specific risk factors differently, just as the odds of developing lung cancer are different for smokers than for nonsmokers, and the chance of having a heart attack varies with the kind of diet a person has.

The potential effect on health is only one of many factors that should go into choosing a birth control method. Couples may also wish to base their decision on how often they have intercourse, how important it is at that point in time to avoid pregnancy or whether they want more children in the future. Their choice may depend on whether they need to use the method at each intercourse (as they would if they selected, say, the condom) or independently of intercourse (if they choose the pill or the IUD). Information provided by friends, health professionals and even advertisements may influence the choice. Each couple is different, and no contraceptive is ideal or best for everyone. In addition, people's needs and options vary over time. Individuals may change partners, marry, divorce or become widowed; their desire for children will likely change with age, as well.

In addition, the AIDS crisis has heightened our awareness of both the prevalence and consequences of STDs. If a woman acquires certain STDs, she may not be able to have children later when she wants to. Women and men today often have to think not only about how well a method will prevent pregnancy and what it might do to their health, but also about how well it will prevent infection.

Scientific knowledge changes over time. What women and men heard or read about the health effects of methods when they chose a contraceptive some time ago may not be supported by subsequent studies. Behind the media's headlines, reports of beneficial effects of birth control methods are accruing, but these reports are published in scientific journals and tend to be read only by medical specialists.

In the past few years, hundreds of new scientific studies have been released that deal with the health effects of birth control, and thousands more have been published that increase our general understanding of the diseases in question. Many of the issues have changed. For instance, cardiovascular disease has become less common in the population as a whole, smoking has declined among users of birth control pills, and both childbirth and abortion have become safer. In addition, some new methods have come onto the market. New ideas have emerged as to how contraceptives can mod-

ify the risk of cancer and other diseases. All of these changes mean that it is time to take a new look at the benefits and risks of contraceptive methods. *Preventing Pregnancy, Protecting Health* responds to this need.

This book follows in the tradition of a 1983 Alan Guttmacher Institute publication, *Making Choices: Evaluating the Health Risks and Benefits of Birth Control Methods.* Like the earlier work, *Preventing Pregnancy, Protecting Health* describes the current state of knowledge about the health consequences associated with the contraceptives available today. But it has a wider focus, appropriate to our expanded concerns. It explores not only how the different methods will affect the chance that a woman will have an unintended pregnancy, but also their influence on the chance that she will become infertile as a consequence of an STD.

Preventing Pregnancy, Protecting Health also differs from *Making Choices* in that it considers not only the short-term effects of birth control, but also how some of the methods may affect health in the future, 10–20 years after they are used, even long after the need for contraception has passed. Deaths from AIDS, for instance, may occur 10 years or more after acquiring HIV infection—so the use of condoms at a time when a person is at risk of infection can have an important benefit many years later. Similarly, cancer is diagnosed more often among women in their 30s than among those in their 20s, and considerably more often among those in their 40s and 50s; a woman's use of a contraceptive early in her reproductive years may influence the way a cancer grows, long before it is detected.

This long-term view reflects a move in the medical and lay world toward "health promotion"—an attempt to improve chances for good health throughout life, not simply to respond to diseases as they occur. Just as proper diet, regular exercise and avoidance of obesity and smoking have potential long-term effects on health, contraceptive choices have implications for health that may become apparent many years later.

Preventing Pregnancy, Protecting Health consists of four sections. We first address the context of contraceptive use in the United States by examining levels of sexual activity and unintended pregnancy, the contraceptive methods currently available, their use among sexually active women and the degree to which contraceptive users are successful in preventing pregnancy. Next, we focus on future fertility; we discuss the importance of number of sexual partners and contraceptive choice on the risks that threaten women's reproductive health and future ability to bear children. In the third section, we explore the direct impact some contraceptives have on women's health, specifically cancer and cardiovascular disease. Finally, we assess the total effect of contraceptive use on women's health by looking at pregnancy-related and method-related morbidity and mortality among women using each method compared with those not using the particular method.

The results of scientific studies on the health effects of birth control do not always agree. Some conclusions are so new or controversial that many scientists question whether they are correct.

Wherever possible, the estimates shown in the figures in this book are based on information that represents a consensus, such as a published comprehensive review of the topic by a recognized scientific expert. Where no consensus exists, where recently published scientific data seem to contradict the previously held ideas, or where we have needed to modify the information available to make it applicable to women in the United States, we have mentioned this in the text and explained the issue more fully in the notes.

In this book, we use simulation models—so-called because they represent the experience of a hypothetical group of women—to measure the implications of the various observed risks that women face for their health and fertility. The purpose of these models is to examine our current knowledge in a framework that makes comparable the contraceptive choices in light of their differing risks. Like all models, these include assumptions that greatly simplify the real world and do not take into account all of the factors that can affect the outcomes for individual women. Appendix A provides an explanation of the simulation models, and appendix B provides the method-specific contraceptive failure rates used in the models.

Most of our comparisons involve estimates of the numbers of adverse health events that will occur in groups of 100,000 women using each method over a period of time, usually a year. We compare such large groups because most effects, fortunately, are quite rare; expressing them in terms of 100 women (percentages) would yield very small numbers that are not easy to comprehend or compare. The rates we present here cannot be used to predict what will happen to an individual woman; instead, they indicate the likely effect of each method on a large group of women. Specific information on the calculation of these estimates and the reasoning behind them appear in the notes to text and notes to figures.

The methods we discuss are those currently available and being used in the United States, including one just recently approved by the Food and Drug Administration (NORPLANT®), as well as long-acting injectable hormonal methods, such as Depo-Provera, that are used in many other countries and may have been used by women now living in the United States.

We compare health outcomes among sexually active women using the different contraceptive choices with those among similar women using no method, and we have subdivided the latter into those who, if they become pregnant, choose to give birth and those who choose to have an abortion.

Preventing Pregnancy, Protecting Health focuses on the prevention of pregnancy for individuals who are having intercourse and do not want to have children now. While abortion is a means of birth control, its purpose is that of terminating a pregnancy that has already occurred. We examine the health implications of whether an unintended pregnancy ends in birth or abortion, but we do not investigate differences in whether a birth is delivered vaginally or by cesarean section or in what method of abortion is used; we also do not make any projections about how our estimates might change if and when such methods as RU 486 become available in the United States.[7]

Our reason for subdividing the group of nonusers who become pregnant into those giving birth and those choosing abortion is to draw attention to the severely negative consequences of relying on luck rather than a contraceptive. Abortion itself is not particularly threatening to a woman's health, but women using no method who choose abortion rather than birth will have many more, shorter pregnancies and will therefore spend more time facing the negative health implications of not using a method. We therefore include this comparison to show that even when abortion is chosen, using no method is a poor method of birth control.

We have limited ourselves to comparisons of methods as they affect three major objectives—preventing pregnancy, preserving future fertility and protecting health. It is also important to keep in mind what we do not cover in this book. We do not examine all risks and benefits of the contraceptives, and we do not attempt to take an in-depth look at each method. In addition, we do not attempt to cover all issues related to women's reproductive health. For example, we have not included a comprehensive treatment of STDs. These diseases can cause serious health problems for women, their infants and their partners, but we focus only on their effects on women's reproductive health and fertility. We also, therefore, do not examine the health effects of the most dangerous STD—HIV.

Many of our estimates of the relative impact of the use of barrier and spermicide methods on the prevention of STD infection would be expected to apply equally to the risk of HIV infection. The relationships between sexual behavior, contraceptive use and transmission of HIV are complex and are currently receiving far more specialized and thorough attention than we would be able to adequately represent within the context of this study. For this reason, we have chosen not to attempt to estimate the impact of contraceptive use on the risk of HIV infection.

Preventing Pregnancy, Protecting Health is not the final word on the health effects of contraceptive use; research continues, and the development of new methods is under way. But people cannot wait for the final word. They must make choices now, and they need the best information available in order to make appropriate choices. We cannot recommend an ideal contraceptive for all couples. Rather, we present the implications of options that women and their partners will have to weigh in light of their own life situations, behaviors and aims. We offer this book as another step toward helping American couples reach their family-building goals.

Contraceptive Use in the United States

CHAPTER TWO

Sexual Activity and Unintended Pregnancy

SUMMARY

The majority of sexually active women in the United States are trying to postpone childbearing or prevent it altogether, but many are not successful. More than half of pregnancies that occur each year are unintended.

In the United States today, two-thirds of all women in their reproductive years (ages 15–44) are currently sexually active and do not want to have a baby now, but are physically able to do so; such women are said to be at risk of having an unintended pregnancy, whether or not they are practicing contraception (Figure 2.1).[8] This includes those women who would be able to have a baby if they were not relying on contraceptive sterilization, an extremely effective but not foolproof method of contraception.

FIGURE 2.1

Two-thirds of American women aged 15–44 are at risk of unintended pregnancy—they are sexually active, are physically able to become pregnant and do not want to have a child now.

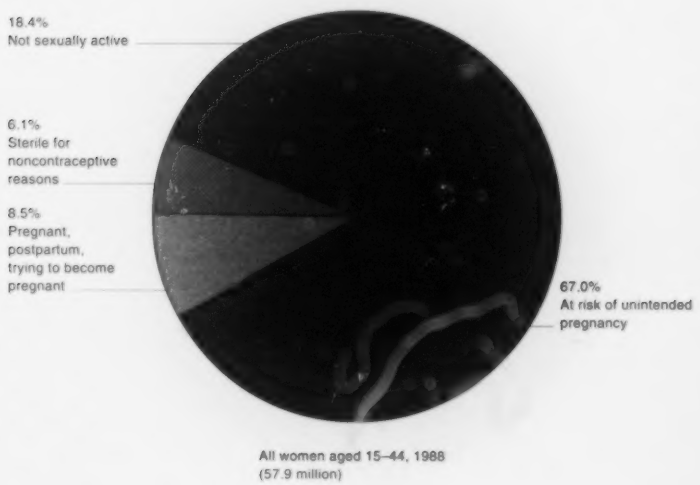
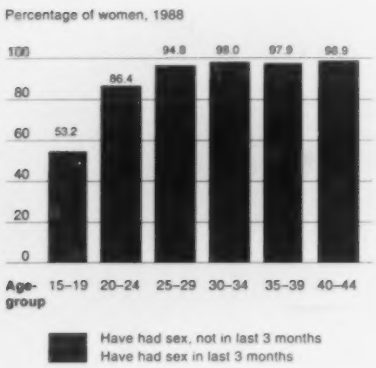


FIGURE 2.2

Nine in 10 women aged 20–44, and over half those aged 15–19, have had intercourse; most are currently sexually active.



As shown in Figure 2.2, the majority of women in their reproductive years are currently sexually active—that is, they have had sex in the past three months. By their early 20s, most women have had sex at least once, and about three-quarters are currently sexually active. More than half of all women aged 15–19 have had sexual intercourse.

Few young women are physically unable to become pregnant (Figure 2.3). The proportion of women who are infertile rises with age, partly because older women and their partners have had more time to become exposed to diseases or illnesses that can impair their ability to have a child.

At any given time, at least four percent of women under age 40, and more than 10 percent of those between the ages of 20 and 34, are not at risk of unintended pregnancy because they are currently pregnant, have given birth very recently (within the last two months) or are trying to become pregnant (Figure 2.4).

As Figure 2.5 shows, four in 10 teenagers and more than two-thirds of older women are currently at risk of unintended pregnancy. Most of those under age 30 who are at risk intend to have a child in the future. The overwhelming majority of older women intend to have no more children.

FIGURE 2.3

While few young women are infertile, about one in five women aged 40–44 are physically unable to have a child because of illness or surgery other than contraceptive sterilization.

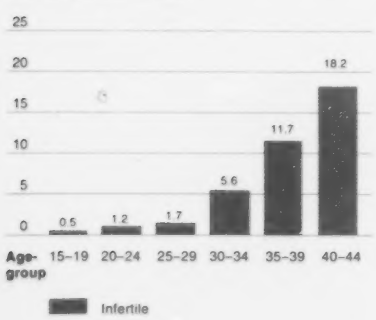


FIGURE 2.4

At any given time, more than one in 10 women aged 20–34 are pregnant, postpartum or seeking pregnancy.

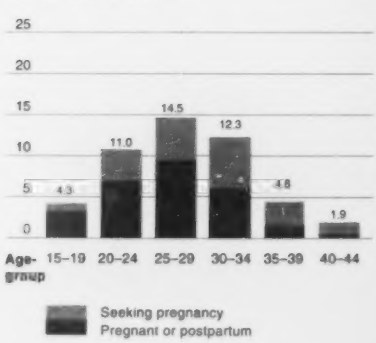


FIGURE 2.5

Over two-thirds of all women 20–44 are at risk of unintended pregnancy. Most younger women want to have children later. The majority over the age of 30 intend to have no more children.

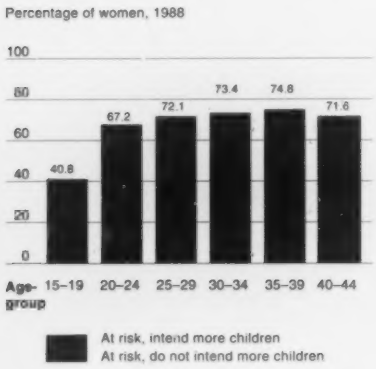


Figure 2.5 reveals that to many women, preserving the ability to become pregnant at some later point is likely to be as crucial as avoiding pregnancy is at the present time. Thus, the contraceptive choices these women make must address the need both to prevent unintended pregnancy now and to protect future fertility.

Pregnancies do occur among sexually active women who wish to avoid them. In fact, as shown in Figure 2.6, more than half of the pregnancies that occur each year in the United States are unintended. Unintended pregnancy occurs at all ages, but it accounts for the majority of pregnancies conceived by women under 25 (Figure 2.7). Among older women, it represents smaller, yet substantial proportions.

Not all pregnancies result in births. Some women experience spontaneous abortions (miscarriages), and others terminate their pregnancies with induced abortions. Figure 2.8 shows rates of births, induced abortions and spontaneous abortions in 1987, by women's age at conception. Among the youngest women—those aged 15–19—pregnancy ends in spontaneous or induced abortion nearly as often as it ends in birth. Women between the ages of 20 and 34 are far more likely to have a birth than to have an induced or spontaneous abortion. Pregnancy among the oldest women

FIGURE 2.6

More than half of the approximately six million pregnancies in the United States each year are unintended.

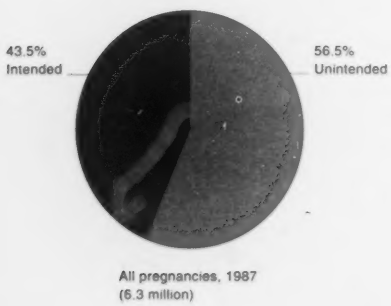


FIGURE 2.7

Most pregnancies each year among women under age 25 are unintended, as are substantial proportions of pregnancies among older women.

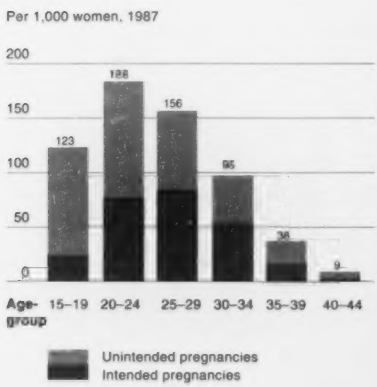


FIGURE 2.8

Among women aged 15–34, at least one in 10 are pregnant each year; young women are the most likely to have unintended births.

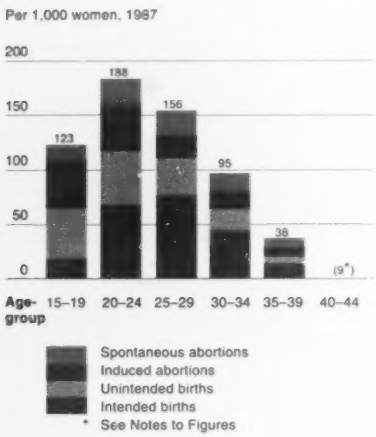
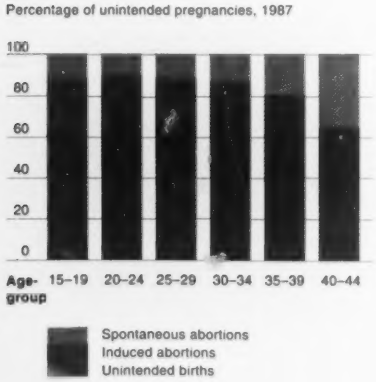


FIGURE 2.9

About as many unintended pregnancies end in induced abortions as in births, except among women 35 and older, who more often choose abortions than give birth.



is almost equally likely to end in birth, induced abortion or miscarriage. Thus, the outcome of pregnancy varies considerably according to the woman's age.

Whereas Figure 2.8 shows the outcome of all pregnancies, Figure 2.9 focuses specifically on unintended pregnancies. The latter reveals that for almost every age-group, unintended pregnancies are at least as likely to end in induced abortion as in birth.

In 1987, about 1.5 million American women had births resulting from unintended pregnancies.[9] Of those births, 31 percent were unwanted—that is, they occurred among women who, prior to pregnancy, had wished not to have another child.[10] The remaining 69 percent were mistimed—they occurred earlier than the women desired.[11] Another 1.6 million women had induced abortions, and 444,000 had unintended pregnancies that ended in spontaneous abortions.[12]

Unintended pregnancy, therefore, is not a rare event, and more than two-thirds of American women between the ages of 15 and 44 currently want to prevent it. Women spend roughly half of their adult lives in the reproductive years; clearly, the contraceptive choices available to them are critical.

CHAPTER THREE

Contraceptive Methods

SUMMARY

The contraceptive methods currently available in the United States vary widely in how they work to prevent pregnancy and in what they require of the users.

In this chapter, we review the contraceptive options currently available to sexually active couples trying to prevent pregnancy, and provide a brief description of the methods' basic modes of action in preventing pregnancy and some of their main benefits or attractions. We discuss all the methods that are currently available in the United States, including implants—which were recently approved by the Food and Drug Administration (FDA)—and injectables. These latter methods are used in other industrialized and developing countries and have been used by some women who have moved to the United States.

Many of the labels traditionally used to classify the range of available birth control choices no longer accurately reflect the most important characteristics of the methods. For example, one cannot simply distinguish "effective" contraceptives from "ineffective" ones. Some methods that are usually considered less effective in preventing pregnancy can be quite effective for couples who are able to use them carefully and consistently. In addition, increasing concerns about the prevalence of sexually transmitted diseases (STDs) have recently highlighted the fact that certain methods can prevent not only pregnancy but STDs, including HIV, as well.

We have grouped contraceptives into five categories, which we ordered to form a rough continuum in terms of the methods' modes of action and degrees of permanence: behavioral methods (periodic abstinence and withdrawal), barrier and spermicide methods (the condom, the diaphragm, the cervical cap, the sponge and spermicides), mechanical and mechanical-hormonal methods (IUDs), hormonal methods (oral contraceptives and long-acting implants and injectables) and surgical methods (tubal sterilization and vasectomy). Other groupings of these methods certainly are possible; for example, withdrawal, the condom and vasectomy are used by males. In addition, the categories are not mutually exclusive; for example, placement of long-acting hormonal implants requires a surgical procedure (although it is a minor operation).

Periodic Abstinence

The effectiveness of these methods depends both on accurately predicting when ovulation will occur, or detecting when it has happened, and on abstaining from intercourse during the woman's

fertile period—before and around the time of ovulation. There are a variety of ways to determine this fertile period. They include the calendar rhythm method, the basal body temperature (BBT) method, the mucus (Billings or ovulation) method and the symptothermal method. All of these require users to abstain from intercourse for particular periods in the woman's cycle. Many people group them together as "rhythm," but others argue that rhythm describes only the calendar method, the least effective of the four. They are also referred to as "natural family planning" methods.

The calendar method involves estimating the onset of ovulation and the duration of the woman's fertile period on the basis of the history and timing of her menstrual cycles. With the BBT method, the woman determines when she ovulates by noting changes in her body temperature. The mucus method entails watching for changes in the consistency of cervical mucus to determine the timing of ovulation. The symptothermal method is a combination of the mucus and the BBT methods, with the additional component of observation of other signs of ovulation—mainly ovulatory pain—to pinpoint the fertile period even more precisely. Among all U.S. women who rely on periodic abstinence, three-quarters use the calendar method.[13]

Some users choose periodic abstinence because it is the only contraceptive method allowed according to the teachings of the Roman Catholic church. Others do so out of a desire for a method that involves no drugs, devices or surgery.

Women who have irregular menses or a history of anovulatory cycles are poor candidates for any kind of periodic abstinence technique, and women who have irregular temperature patterns cannot use the BBT method. All of these methods require a willingness to refrain from intercourse during relatively long periods (as much as half of every menstrual cycle), and use of the BBT and the symptothermal methods requires keeping accurate records of menstruation, temperature and other signs.[14]

Some couples use these methods to predict ovulation or to determine when it has occurred, but they avoid the necessity of abstaining from intercourse by using a barrier or spermicide method throughout the fertile period.

Withdrawal

Withdrawing the penis from the vagina before ejaculation (coitus interruptus) requires no drug or device and involves no cost or advance preparation. However, withdrawal is a very ineffective method to use if the male partner has less-than-perfect ejaculatory control; if he ejaculates before withdrawing, relying on this method is equivalent to using no method at all. Furthermore, even if the male partner withdraws before ejaculation, preejaculatory fluid that may have been left in the vagina can cause pregnancy.

Barrier and Spermicide Methods

The methods in this group—the condom, the diaphragm, the cervical cap, the contraceptive sponge and spermicides—are reasonably effective when used perfectly, that is, carefully, correctly and consis-

tently.[15] However, few couples seem to be able to use these methods perfectly The relatively high failure rates associated with them are most likely due to irregular or imperfect use. Because couples must apply or insert barrier and spermicide methods prior to intercourse, they may have to either interrupt intercourse or know ahead of time when they will be having sex. Women often complain that barrier and spermicide methods are inconvenient and messy, and some men report decreased sensitivity with condoms.[16] Couples who find them inconvenient or unpleasant to use may be more likely to take risks—that is, have unprotected intercourse—than those who use methods not linked directly to intercourse.

Condom

This method has been in use for centuries. Because condoms must be placed on the erect penis, they must be used at the time of intercourse. Today, almost all condoms are made of latex rubber, although about one percent of those sold in the United States are processed from a part of the intestine of lambs.[17] The latter are the choice mainly of men seeking increased sensitivity and of the very small number who are allergic to rubber.

Condoms come lubricated or dry, straight or shaped, with or without a reservoir tip, transparent or colored, and smooth or textured. They do not require a doctor's prescription and are available in pharmacies, some other stores, and vending machines.

In addition to protecting against unintended pregnancy, condom use can help prevent STDs. Laboratory tests indicate that latex condoms are barriers to all known STDs, but lambskin condoms are not. Latex condoms therefore offer important potential benefits for men and women who are exposed or think they might be exposed to STD infections.

Diaphragm

The diaphragm is a dome-shaped soft rubber cup with a flexible rim that fits in the vagina and covers the cervix. Users should place spermicide, in gel or cream form, inside the cup before insertion and may put the diaphragm in up to six hours before intercourse. The diaphragm itself blocks sperm from entering the cervix, while the spermicide kills any sperm that may get by the barrier. The diaphragm should remain in place for at least six hours after intercourse. The woman should insert more spermicide into the vagina for each additional act of intercourse, leaving the diaphragm in place.[18]

The diaphragm is available in several sizes, requires a prescription and must be fitted by a physician or other qualified health professional, who then trains the woman in its proper placement and removal. Some women cannot use the diaphragm because they are allergic to rubber or spermicide, or because they cannot be fitted. Because of concern about possible risks of toxic shock syndrome, women are advised not to leave the diaphragm in place for longer than 24 hours.[19]

Cervical Cap

The cervical cap is similar to the diaphragm, but it is smaller and depends on suction to stay in place, fitting closely over the cervix. The cap comes in several sizes and must be fitted by a physician or other qualified health professional. Like the diaphragm, the user places spermicide inside the cap before placement and must insert spermicide into the vagina if she has repeated intercourse. The cervical cap can be inserted up to eight hours prior to intercourse, must be left in place for at least six hours after intercourse, and should not be left in place for longer than 24 hours.

Sponge

In contrast to the diaphragm and the cervical cap, the polyurethane contraceptive sponge comes in only one size, can be purchased without a medical examination or prescription, is disposable and contains enough spermicide to provide protection for 24 hours, regardless of the number of times the woman has intercourse. It must be moistened with water before being placed in the vagina, where it covers the cervix. During intercourse, the sponge releases spermicide and also acts as a barrier by absorbing sperm. The sponge can be inserted several hours before intercourse, but must be left in place for at least six hours following intercourse. Because of concerns about toxic shock syndrome, women are advised not to leave the sponge in place for longer than 24 hours.

Some of the potential side effects of the sponge are similar to those found with other spermicidal methods—primarily, a slight burning sensation and an allergic reaction to the spermicide for some women and men. Some men complain that they can feel the sponge during intercourse.

Spermicides

Although spermicides come in various forms—foams, gels, creams, and suppositories and film that dissolve in the vagina—the active ingredient in all these preparations is a detergent (usually nonoxynol-9) that immobilizes and kills sperm. Spermicidal protection is expected to last for several hours, but since there is no device to hold the spermicide (e.g., a diaphragm) when the spermicide is used alone, it is recommended that it be inserted into the vagina shortly before intercourse to provide maximum effectiveness.[20]

Spermicides are probably most effective when used in conjunction with barrier devices (e.g., a diaphragm, cap or condom). Some women and men complain of a slight burning sensation with the use of spermicides. Others are allergic to these preparations and cannot use them at all or cannot use certain brands or forms of spermicide.

IUD

The IUD is one of the most effective reversible methods. Its obvious advantage is that once the device is inserted in the uterus, all the user has to do is make sure it has not been expelled (by feeling for a string that extends down into the vagina). A physician or other qualified health professional inserts the device into the uterus,

where it can remain in place for up to six years (depending on the type of device). The IUD apparently achieves its contraceptive effect by preventing fertilization through its disruptive effects on sperm, sperm transport and ovum, or egg, transport, as well as by initiating a local inflammatory response to a foreign body, which inhibits implantation should fertilization occur.[21]

Two IUDs are currently on the market in the United States: the Copper T 380A (which is sold under the name ParaGard) and the Progestasert. The TCu 380A is a copper-bearing device that became available in 1988. It can be used continuously for up to six years, after which the device must be replaced. The Progestasert slowly releases progesterone, a natural hormone; the device must be replaced after one year of use.

The most common problems associated with use of the IUD involve bleeding, pain, partial or complete expulsion of the device, retraction of the string into the uterus so that the woman can no longer feel it and irritation of her partner by the string. The potential side effects of the different IUDs are similar, except that while the copper IUD tends to increase menstrual bleeding, the Progestasert appears to decrease it.[22] We discuss the risk of more serious complications—pelvic inflammatory disease, ectopic pregnancy and perforation of the uterus—in sections on future fertility and the health effects of contraception.

Oral Hormonal Methods

Combined Oral Contraceptives

Combined oral contraceptives (collectively referred to as the pill) are so named because they contain two synthetically produced hormones—estrogen and progestin. The amount of hormone in each pill may be the same throughout the cycle (monophasic pills) or may vary (biphasic and triphasic pills). The doses of estrogen and progestin contained in oral contraceptives today are far less than those used in 1960, when the pill first became available in the United States.

Combined oral contraceptives' main mechanism of action is the suppression of ovulation so that no ovum is available to be fertilized by sperm. In the small proportion of cases in which the pill does not prevent ovulation, it averts pregnancy through other means: It changes the composition of cervical mucus so that sperm have difficulty penetrating it to reach the uterus and fallopian tubes, where fertilization takes place. Oral contraceptives also slow transport of the egg through the fallopian tube and change the uterine lining to inhibit implantation should fertilization occur.

The most frequent side effects reported with oral contraceptive use are spotting and breakthrough bleeding, as well as conditions that are commonly experienced with pregnancy: nausea, weight gain, breast enlargement, headaches and chloasma (blotchy, brown spots that form on the face, often called the "mask of pregnancy").[23] Such side effects, other than spotting and breakthrough bleeding, are less common with pills used today than they were with the older, higher dose formulations. The lower the dose of estrogen in the pill, the more likely spotting and breakthrough bleeding are

to occur.[24] In later sections, we discuss the association of oral contraceptive use with more serious complications (heart attack, stroke, blood clot formation and cancer).

Progestin-Only Pill

An alternative form of oral contraceptive contains only progestin. It is often called the minipill since it contains a considerably lower dose of hormone than the combined pills. However, the minipill does not suppress ovulation as effectively as the combined pill, and it is thus less effective in preventing pregnancy. The minipill also prevents pregnancy by causing a thickening of the cervical mucus, decelerating ovum transport and inhibiting implantation. Irregular bleeding, decreased duration and amount of menstrual flow, amenorrhea, spotting and breakthrough bleeding are commonly associated with use of the minipill.

Postcoital Contraceptives

Combined contraceptives are sometimes used as a morning-after method following unprotected intercourse. Regimes may vary, but all involve taking hormonal pills in multiple doses within 72 hours after intercourse.[25] When taken this way, the pill prevents pregnancy by not allowing implantation if fertilization does occur. The postcoital use of hormonal contraceptives has not been submitted for review by the FDA, and therefore orals cannot be marketed for that use; however, since they are approved for other purposes, physicians may and do prescribe them for women who have had unprotected intercourse.[26]

Long-Acting Hormonal Methods

Like oral methods, implants and injectables release hormones that affect ovulation and implantation. While the FDA only recently approved implants and has not approved any injectables for use as contraceptives in the United States, they are available in many other countries and some U.S. women have used them.

Implants

Contraceptive implants are small capsules that are placed in a woman's upper arm just under the skin. NORPLANT, which has been used in many countries for nearly a decade, was approved by the FDA in late 1990. These implants slowly release a small amount of progestin and remain effective in preventing pregnancy for up to five years after insertion. Like other progestin-based methods, they act through inhibiting ovulation, promoting thickening of the cervical mucus and deceleration of ovum transport, and inhibiting implantation of a fertilized ovum. Implants' most common side effects are the same as those associated with the progestin-only minipill—irregular bleeding and spotting, decreased duration and amount of flow, and amenorrhea.

Injectables

Injectable contraceptives also have been widely available for many years outside the United States, and a small number of American

women have used them. They contain either progestin alone or progestin and estrogen. Medroxyprogesterone acetate (Depo-Provera, or DMPA) is the most commonly used formulation; norethindrone enanthate (NET) is another.

The mode of action and side effects of progestin-only injectables are similar to those of the minipill and implants; many long-term users develop amenorrhea. Depo-Provera has been approved by the FDA for use in the treatment of a number of gynecologic conditions and at menopause, but not as a contraceptive. However, since it is approved for other uses, physicians may prescribe it for contraceptive purposes.[27] Each injection maintains its contraceptive effect for approximately three months, at which time the user must return to a doctor or clinic for another injection.

Surgical Methods of Contraception

Tubal Sterilization

Tubal sterilization (also called tubal ligation or tying of the fallopian tubes) involves a surgical procedure in which sections of each fallopian tube are blocked or severed so that the ovum and sperm are not able to meet. It can be performed postpartum or at a time not associated with a delivery or abortion. An interval sterilization—one not associated with the postpartum period—can be performed under local anesthesia on an outpatient basis. This is a relatively simple surgical procedure, and requires that the woman spend only a few hours in a recovery room before returning home. Sutures, electrocoagulation, clips, bands or rings are used to close or sever the tubes.

Tubal sterilization must be viewed as a permanent method. Although the two ends of the tubes can sometimes be reconnected by microsurgery (depending on the type of technique used, the length of fallopian tube destroyed during the sterilization operation and the location of the tubal destruction), the surgery can be complicated, expensive and difficult, and success cannot be guaranteed.[28]

Vasectomy

Male sterilization involves cutting and sealing the vas deferens, a narrow tube through which the sperm travel from the testes, so that sperm will not be present in the ejaculate. A vasectomy is a simple procedure that usually takes place in a doctor's office or outpatient clinic under local anesthesia. Complications that may occur are almost always minor and of brief duration (mainly swelling, discoloration and discomfort). Vasectomy, too, should be considered a permanent method. Reversal is sometimes possible, but the surgery is costly, and success cannot be guaranteed.

CHAPTER FOUR

Current Use of Contraceptives

SUMMARY

The choice of a contraceptive method is strongly affected by a woman's or couple's childbearing plans. Among women who intend to have a child in the future, the most popular methods are oral contraceptives and the condom, while among women who do not intend to have any more children, their own or their partner's sterilization is the preferred method.

Most women who are at risk of unintended pregnancy use some method of birth control. Figure 4.1 shows the proportion of all women who want to avoid pregnancy using each method. Ten percent use no method at all. The pill is the most commonly used reversible method (the choice of 28 percent of women at risk), and the condom follows (13 percent). Over one-third of all women at

FIGURE 4.1

Oral contraceptives and sterilization are the methods most commonly used by American couples.

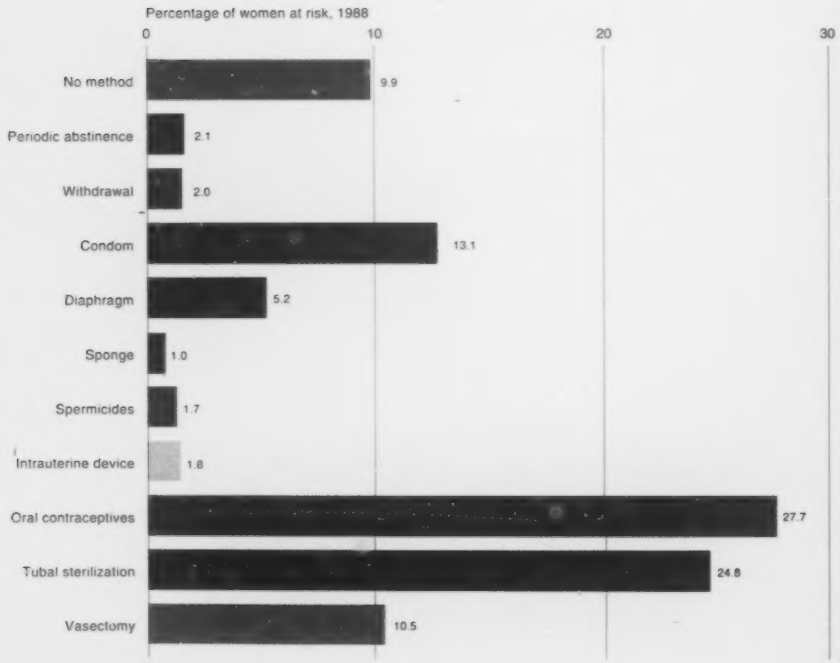


FIGURE 4.2

Women at risk of unintended pregnancy who intend to have a child in the future are most likely to use oral contraceptives, or barrier or spermicide methods.

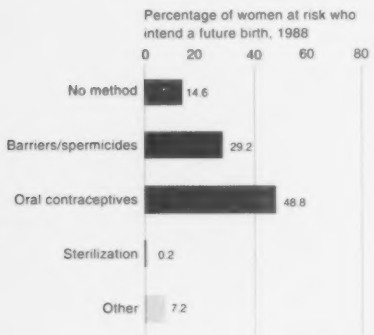
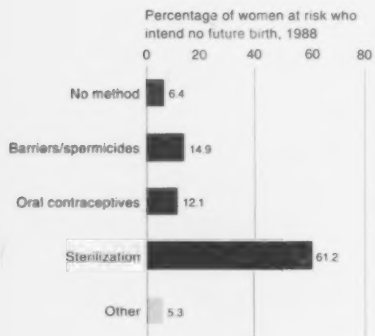


FIGURE 4.3

Women at risk of unintended pregnancy who intend not to have a child in the future are most likely to rely on sterilization.



risk rely on contraceptive sterilization—25 percent have had a tubal sterilization, and 11 percent are protected by their partner's vasectomy.

Figures 4.2 and 4.3 demonstrate how contraceptive choices differ according to whether or not a woman intends to have a child in the future. Women who intend to have a child in the future are more likely than those who do not to use no method of contraception even though they say they do not want to have a child now. They are also far more likely to use oral contraceptives. While the pill and barrier and spermicide methods are the most frequent choices of women who plan to have children in the future, contraceptive sterilization is the most frequently used method among those who do not intend to have more children. Six in 10 women at risk of unintended pregnancy who intend to have no more children rely on contraceptive sterilization—primarily on tubal sterilization. Other women who do not plan to have more children are about as likely to use the pill as they are to use barrier and spermicide methods.

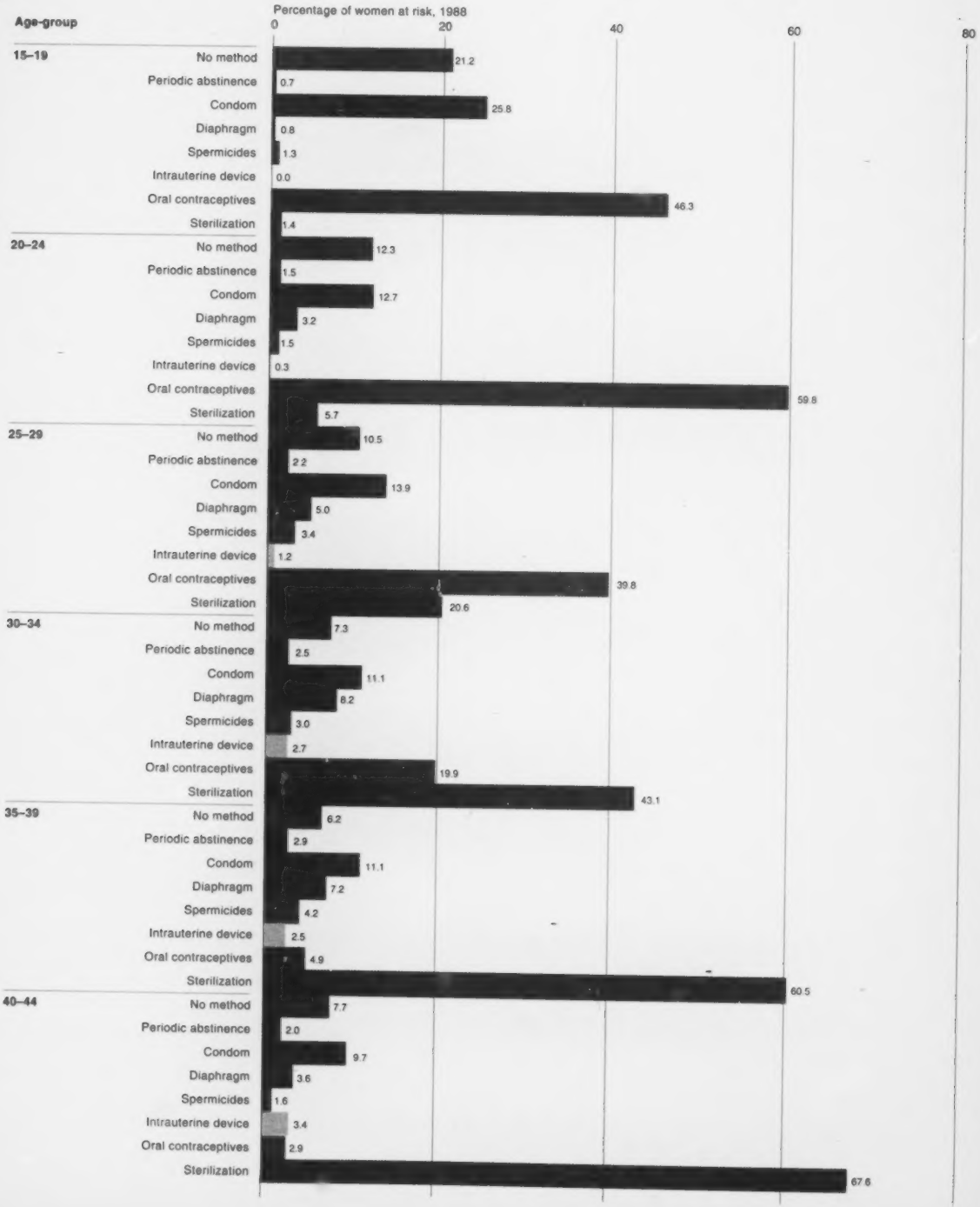
Figure 4.4 shows how contraceptive choices vary among women of different age-groups. Among women at risk of unintended pregnancy, roughly one in five aged 15–19, one in 10 in their 20s and one in 15 older women currently use no method. Pill use is most common in the early stages of women's reproductive lives: The proportion of those at risk who use the pill is 40–60 percent among women under 30, compared with 20 percent of women aged 30–34 and just 3–5 percent of those aged 35–44.

As is evident in Figure 4.4, American couples choose sterilization in increasing proportions at just about the same time that their use of the pill declines. The proportion of women at risk of unintended pregnancy who rely on sterilization rises steadily from 21 percent aged 25–29 to 68 percent of those 40–44.

The only other method used by at least 20 percent of women in any age-group is the condom: Twenty-six percent of women aged 15–19 who are at risk of unintended pregnancy rely on the condom. Use at other ages ranges from 10 percent to 14 percent of those at risk.

FIGURE 4.4

In the early stages of their reproductive lives, women at risk of unintended pregnancy are likely to use oral contraceptives; most older women rely on sterilization.



CHAPTER FIVE

Pregnancies Occurring During Contraceptive Use

SUMMARY

Some contraceptive methods are associated with higher rates of unintended pregnancies than are others. Couples using a method that requires interruption of or abstinence from intercourse are more likely than others to experience a contraceptive failure.

Although ineffective use of contraceptives and failure of the methods account for a large fraction of unintended pregnancies and births, couples who do not use contraceptives account for a higher proportion of unintended pregnancies and births than those who do use them. The 10 percent of women at risk of unintended pregnancy using no method account for 53 percent of the 3.5 million unintended pregnancies that occur annually (Figure 5.1). Although the largest proportion of unintended pregnancies in 1987 among women not practicing contraception ended in induced abortions (48 percent), a substantial share ended in births (40 percent) (Figure 5.2).

Forty-seven percent of all unintended pregnancies occur while women are using contraceptives (Figure 5.1). In 1987, approximately 41 percent of these pregnancies ended in induced abortions and 46 percent ended in births (Figure 5.2).

Some contraceptive methods are more effective at preventing pregnancy than others. For example, women using the IUD have many fewer pregnancies than those using the diaphragm. An important determinant of how well a contraceptive works is the ability and

FIGURE 5.1

Nine in 10 women at risk of unintended pregnancy are using contraceptives; the small proportion of women who do not use a method account for over half of all unintended pregnancies.

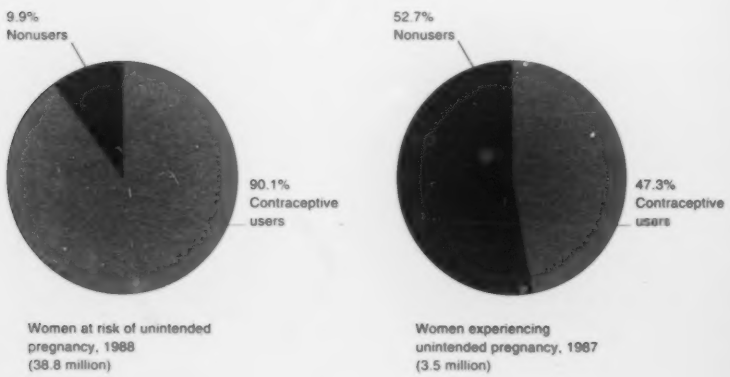
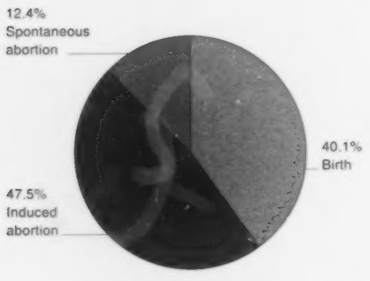


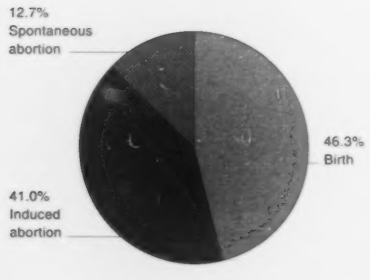
FIGURE 5.2

Unintended pregnancies are almost as likely to result in birth as in induced abortion, whether they result from not using contraceptives . . .



Unintended pregnancies among nonusers, 1987 (1.9 million)

. . . or they follow contraceptive failure.



Unintended pregnancies among contraceptive users, 1987 (1.7 million)

motivation of the user to use the method carefully, correctly and consistently. Although the available methods differ in their inherent ability to prevent conception, they vary even more in how easy they are to use and how attractive they are to users. For example, women who use oral contraceptives must remember to take a pill every day, but in contrast to those whose partners use a condom, they do not have to interrupt sexual intercourse to use the method. Periodic abstinence requires the cooperation of both partners, while most other methods do not.

Figure 5.3 shows estimates of pregnancy rates among U.S. women aged 15–44 in the first year of use for each method (not necessarily the first time they have ever used the method; see appendix B). These low and high rates reflect the differences in contraceptive failure rates between groups of couples who are more or less likely, respectively, to use each method exactly as it is supposed to be used. The low rate for a particular method represents the rate among a group of couples in which many use the method perfectly (i.e., consistently and correctly). Still lower rates of failure than the figure shows would be possible with most of these methods if all couples were to use the method perfectly or even almost perfectly.

High failure rates reflect greater levels of imperfect use. The difference between the low and high rates is larger for methods that are used around the time of intercourse than for those that require little user attention. For example, withdrawal, periodic abstinence and barrier and spermicide contraceptives have a wider range of failure rates than the IUD or long-acting hormonal methods.

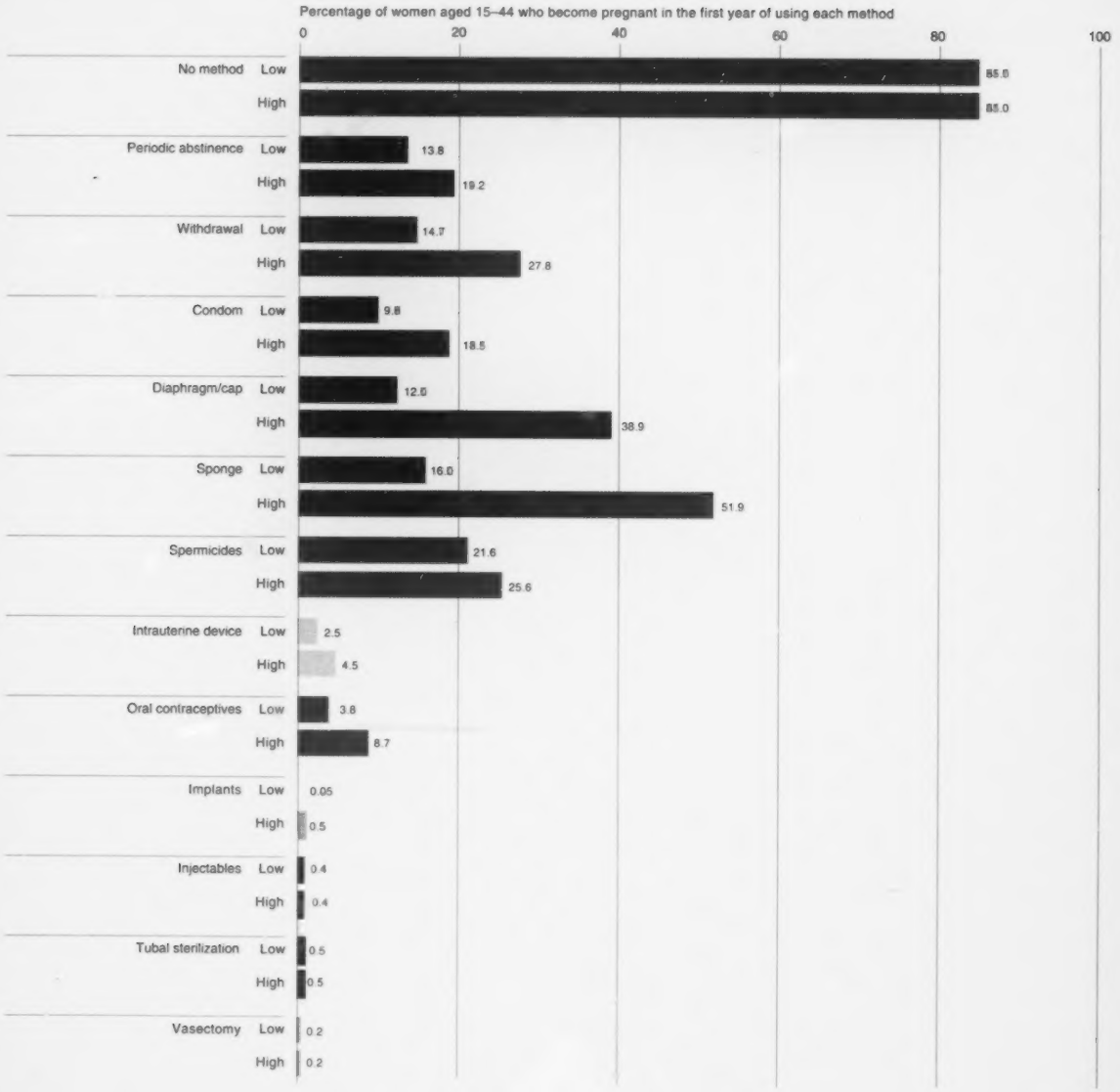
A woman who does not use a contraceptive is very likely to become pregnant within a short period of time. Among women using a contraceptive method, those relying on methods that are linked to intercourse—barrier and spermicide methods, withdrawal and periodic abstinence—generally have the highest pregnancy rates. Condom users have the lowest rate among this group.

Of all methods whose use is not linked to intercourse, oral contraceptives are associated with the highest pregnancy rates—an estimated four percent of women in the low failure rate group will become pregnant during the first 12 months of pill use. Because of the multiple effects the pill has on a woman's reproductive system, oral contraceptives should have extremely low failure rates if used correctly. Many pill users, however, have difficulties using the pill correctly: They forget to take it every day or at the same time every day, or they do not use a backup method when pills are missed.[29]

Pregnancy rates associated with methods that do not require much or any user attention are low, ranging from an estimated three percent among women in the first year of IUD use to less than one percent among those relying on injectables, implants or sterilization. These rates vary little, if at all, according to the users' behavior.

FIGURE 5.3

Pregnancy rates vary widely depending on which, if any, contraceptive a couple chooses. In addition, pregnancy rates for most contraceptives are greatly affected by how consistently and correctly the methods are used.

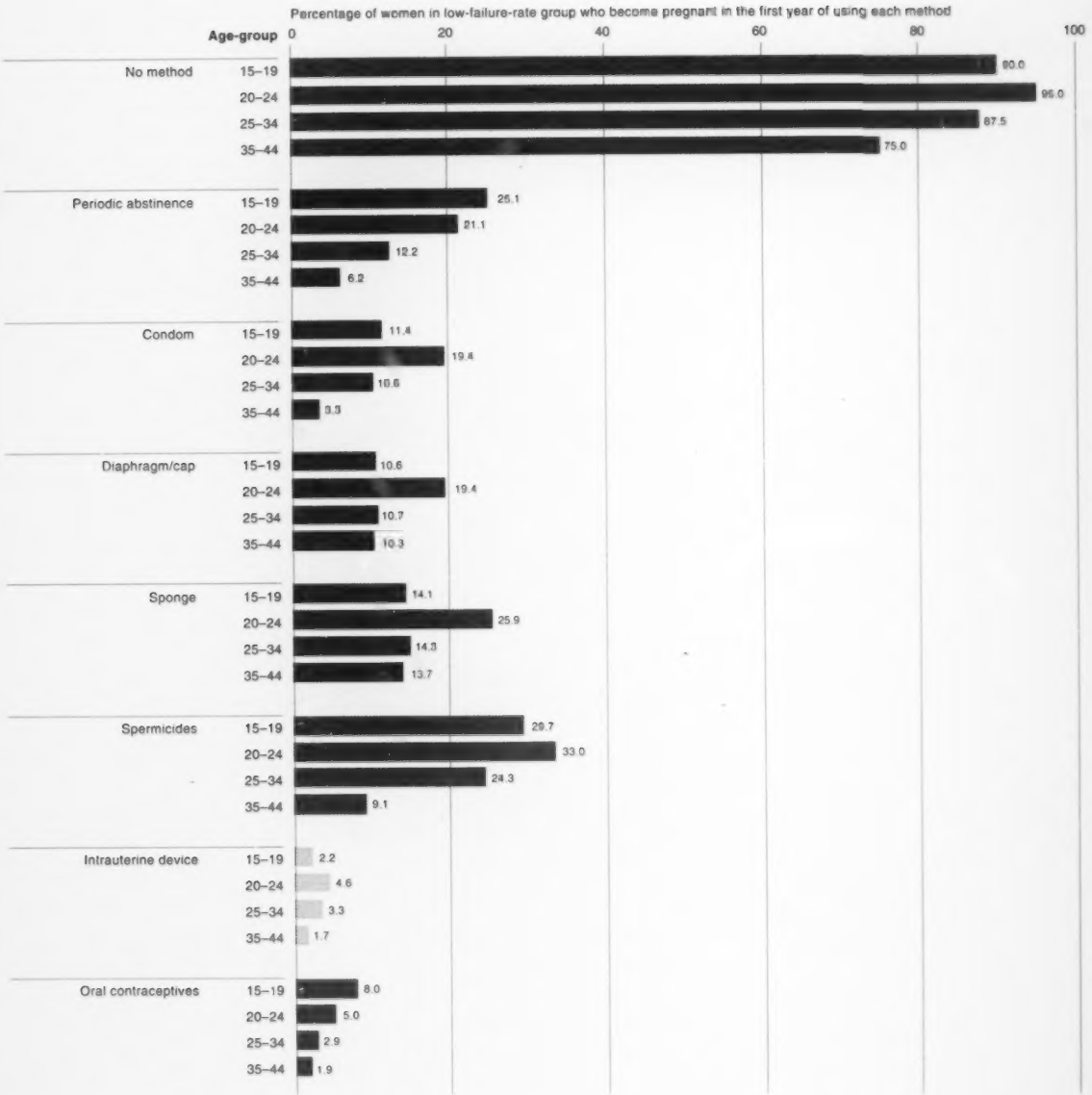


Low refers to the low rates of pregnancy observed among some groups of women who are more likely than average to use the methods correctly and consistently.

High refers to the high rates of pregnancy observed among some groups of women who are less likely than average to use the methods correctly and consistently.

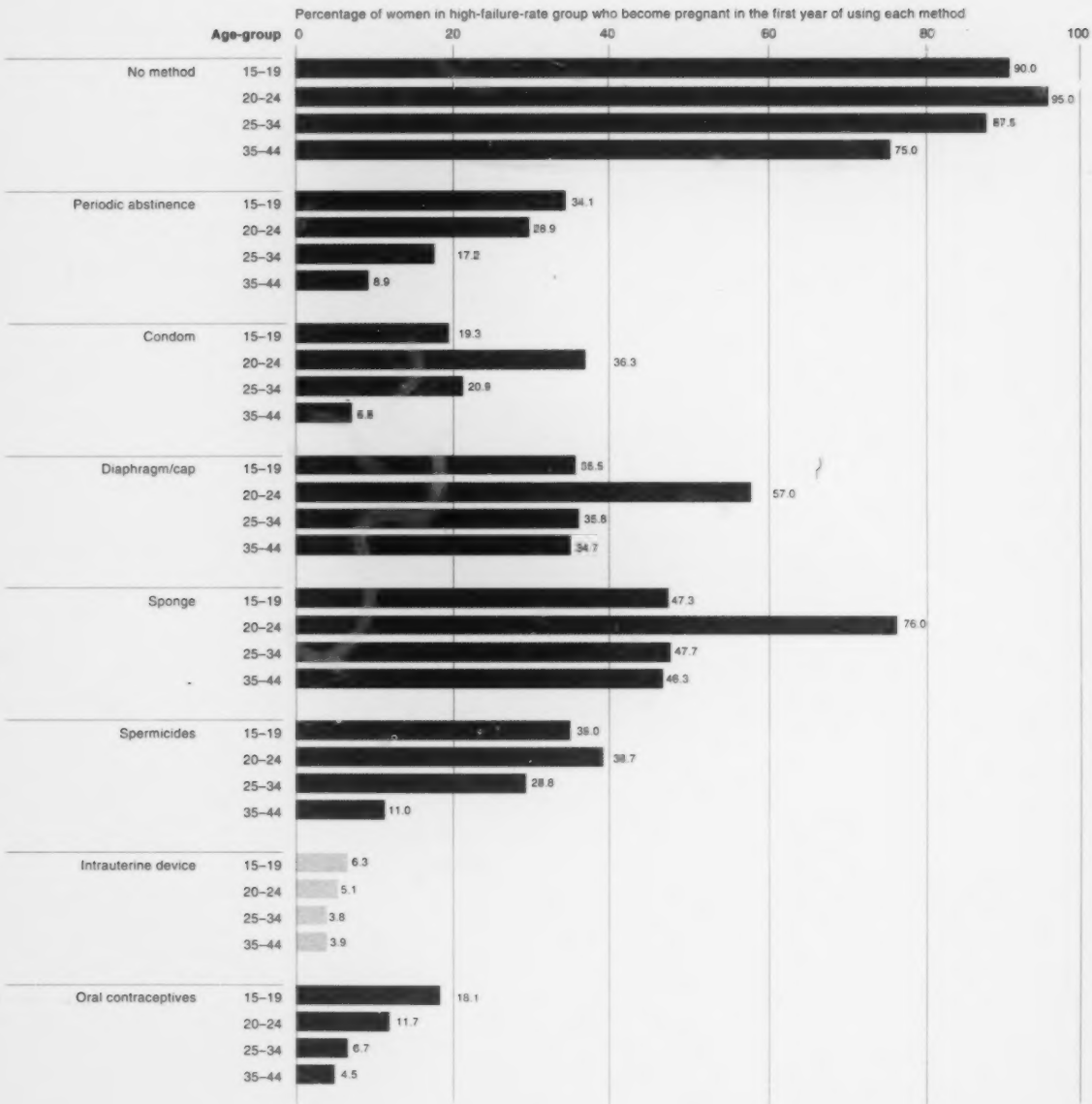
FIGURE 5.4

Pregnancies are most common among those aged 15–24 for both women with relatively low contraceptive failure rates . . .



Low refers to the low rates of pregnancy observed among some groups of women who are more likely than average to use the methods correctly and consistently.

. . . and women with relatively high failure rates.



High refers to the high rates of pregnancy observed among some groups of women who are less likely than average to use the methods correctly and consistently.

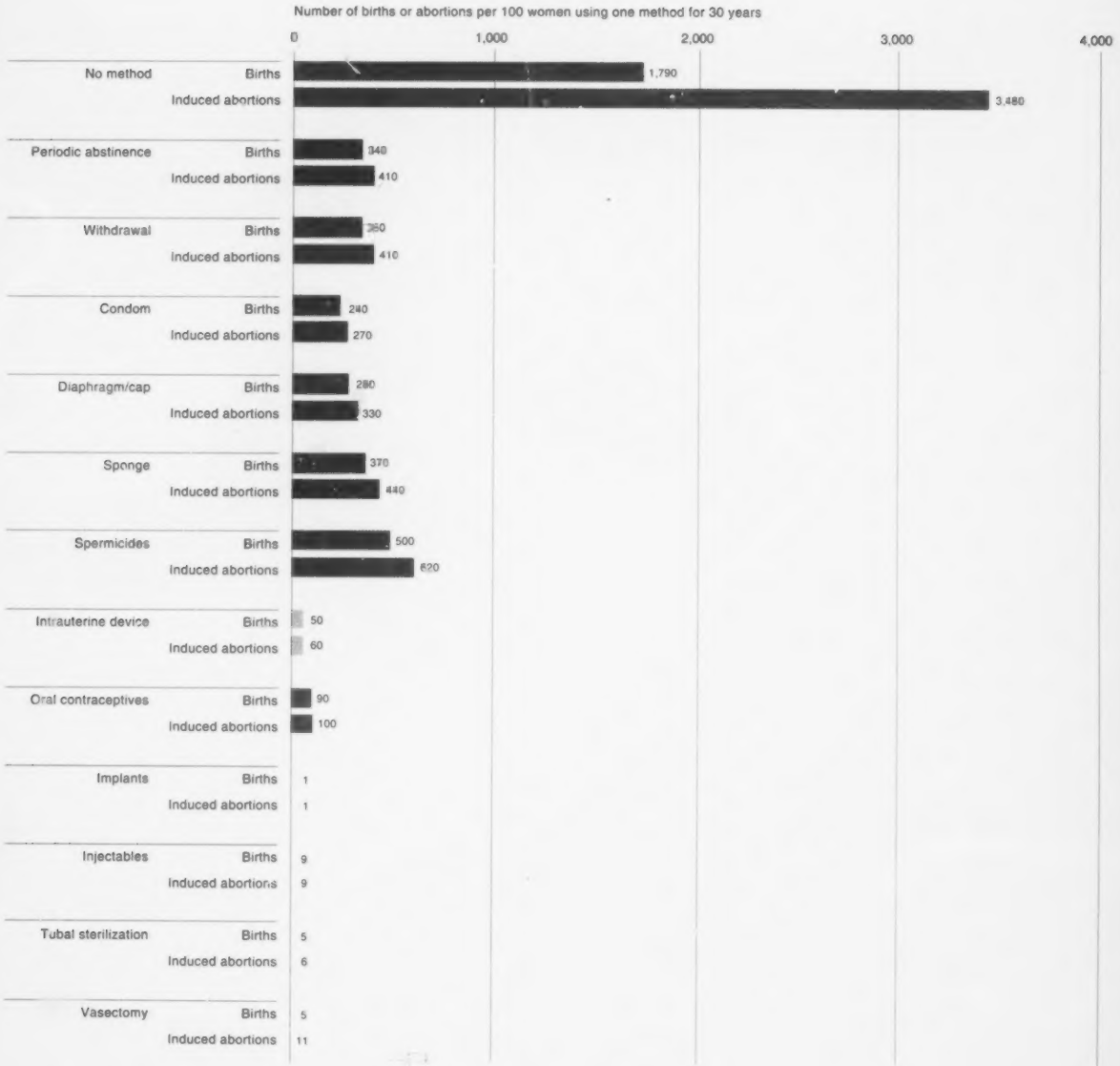
Figure 5.4 shows the range of low and high pregnancy rates among users of the reversible methods most often used in the United States, according to the woman's age-group. For any method, women under age 25 tend to experience higher pregnancy rates than those who are older. Younger women are usually less experienced users, may become pregnant more easily than older women and, especially those aged 20–24, may have intercourse more frequently. Also, the motivation to avoid pregnancy may be greater among older women, who are more likely to already have all the children they want.

Throughout this publication, we do not attempt to assess the health benefits and risks of birth and abortion.[30] We do, however, compare the consequences for health of using various contraceptives with those of using no method and having either a birth or an abortion. The health implications of using each method include not only the direct effects of the method but also the health effects of pregnancy and its outcome if the method fails. Since pregnancy has substantial consequences for a woman's health, the failure rate associated with each contraceptive method is a major determinant of the risks and benefits of that method for a woman's health. Except where otherwise noted, estimates throughout the book are based on the low failure rates of women in each age-group. If we applied the higher failure rates, the level of both positive and negative health outcomes associated with pregnancy would escalate correspondingly.

Figure 5.5 demonstrates the effect of contraceptive use on the number of births and abortions a group of 100 women would have during their lives if they were to use one method throughout their reproductive years and for every pregnancy choose birth or for every one choose abortion (assuming low rates of contraceptive failure). As the figure shows, women who use no method of birth control would experience far more births and abortions—on average, each woman would have 18 births or 35 abortions—than women who use any one contraceptive method for all those years.

FIGURE 5.5

Women who use contraceptives will have far fewer births and abortions over the course of their reproductive lives than if they had used no method at all.



Future Fertility

CHAPTER SIX

Sexually Transmitted Diseases

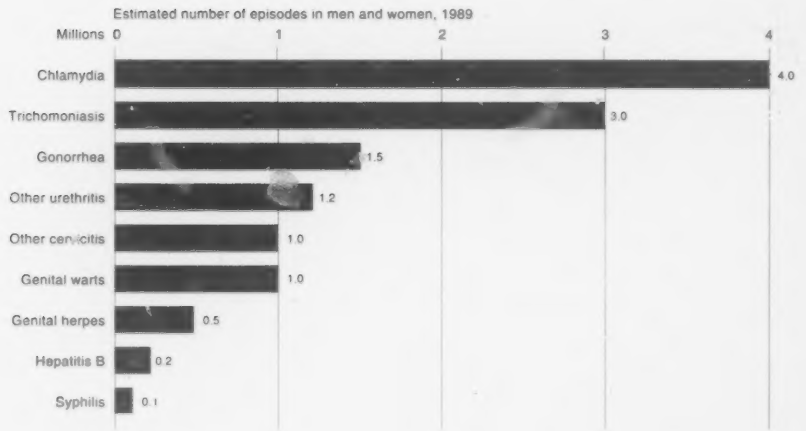
SUMMARY

Most American men and women have more than one sexual partner during their lives. Some, especially young people, have several partners over a relatively short period of time. One potential consequence of having a new partner is acquiring a sexually transmitted disease (STD); such diseases are highly prevalent in the United States. Barrier and spermicide methods can help protect against STDs, but they must be used consistently to be effective.

STDs are among the nation's most common public health problems: More than 12 million episodes occur per year in the United States (Figure 6.1), including 2.5 million among teenagers.[31] Some individuals are infected repeatedly, and many have more than one infection simultaneously.[32]

FIGURE 6.1

More than 12 million episodes of STDs occur annually in the United States.



There are a wide variety of STDs, caused by different organisms and having different effects. Bacterial STDs (e.g., chlamydia and gonorrhea) and some that are caused by other microorganisms (e.g., trichomoniasis and syphilis) can usually be cured by antibiotic therapy. Viral diseases (e.g., genital warts, herpes, hepatitis B and HIV) cannot be cured, but their symptoms can sometimes be alleviated and the disease progression slowed. Although people who have an STD may show no symptoms of illness and may not know they are carrying the disease for a long period of time, they may be able to transmit it to others.

STDs can have serious health consequences for the carrier, both in the short term and in the long term. Women with certain STDs, particularly chlamydia and gonorrhea, can develop pelvic inflammatory disease (PID), which can result in a future ectopic pregnancy or infertility (see chapters 7–9). Some STDs (e.g., syphilis) may increase the risk of spontaneous abortion, stillbirth or premature birth.[33] Many can be transmitted to a woman's offspring during pregnancy or childbirth and can cause infant pneumonia, blindness, mental retardation or death.[34] Individuals infected with certain STDs may be able to transmit the infection for many years,[35] suffer chronic disability, develop cancers as a consequence of the infection,[36] or die from effects of the disease.[37]

People who have more than one partner are at risk of acquiring an STD, as are those who have sex with someone who has had other partners. Two-thirds of all women aged 15–44 who have ever had intercourse have had more than one sexual partner (Figure 6.2).[38] While many women have successive long-term monogamous relationships (referred to as serial monogamy), a sizable proportion of women, and a larger proportion of men, have more than one partner over a short period of time, either because they move from one short-term relationship to another or because they are simultaneously involved with more than one person. A 1988–1989 survey among sexually active Americans aged 18–44 showed that 14 percent of women and 29 percent of men had had more than one sexual partner over the preceding year;[39] of those who reported having done so, 13 percent of women and 33 percent of men reported they had had intercourse with a "casual date or pickup."[40]

Compared with older respondents, younger ones, who were more likely to be unmarried, had had more partners. Among those aged 20–24, some 23 percent of women and 58 percent of men had had more than one partner in the past year, compared with five percent and 14 percent of 40–44-year-old women and men, respectively.[41] A 1988 survey of women found that the youngest respondents were the most likely to have had more than one partner in the preceding three months (Figure 6.3).

Each time a woman changes her sexual partner, she faces the risk of having intercourse with someone who has an STD. Since STDs are so prevalent in the U.S. population, the likelihood that a new partner is infected is far from small. In certain areas of the United States, up to 10 percent of pregnant women have gonorrhea, and much larger proportions have chlamydia, trichomonas and other pathogens.[42] If her partner does have an STD, the probability

FIGURE 6.2

A majority of American women who have had intercourse have more than one sexual partner over their lifetime.

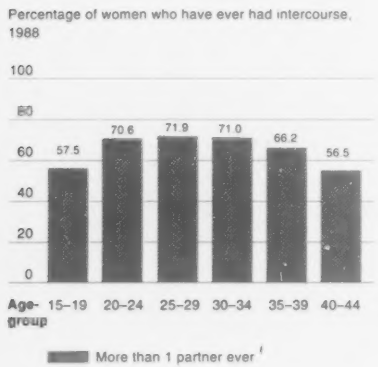


FIGURE 6.3

The likelihood of currently having multiple sexual partners declines with age.

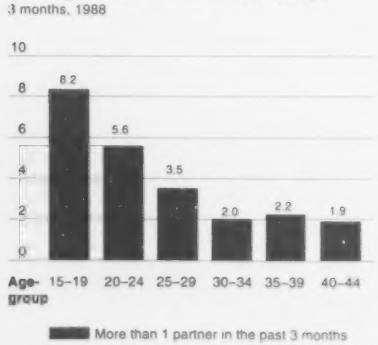
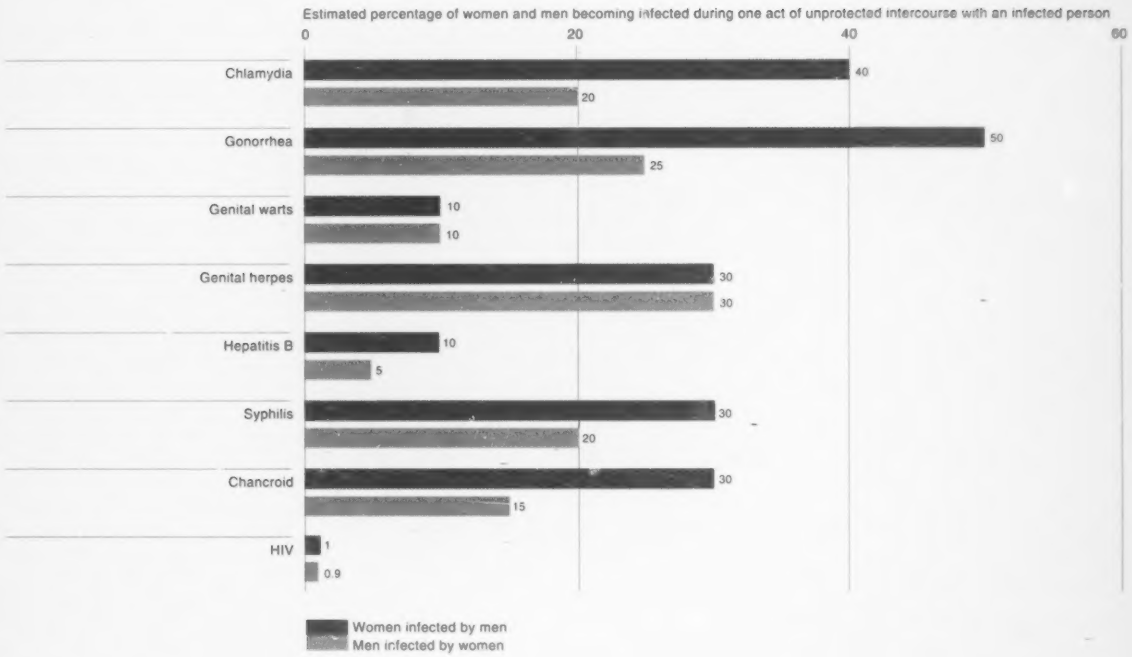


FIGURE 6.4

A single act of unprotected intercourse with an infected person can transmit STDs. In the case of most STDs, women are more readily infected by men than vice versa.

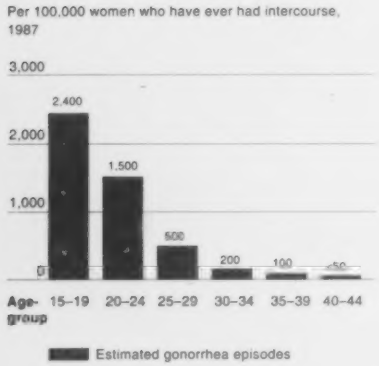


of the woman becoming infected is high (Figure 6.4). For instance, following a single act of unprotected intercourse with an infected man, an estimated 50 percent of women will contract gonorrhea,[43] and an estimated 30–40 percent will contract chancroid, chlamydia, herpes or syphilis.[44] Women seem to be more likely than men to acquire many of the STDs following a single heterosexual act of intercourse with an infected person. Repeated sexual contact with the same infected person poses an even greater risk of transmission of the disease, for both men and women.

Younger women and men acquire more infections in a given period of time, presumably because they have more partners.

FIGURE 6.5

Younger women are the ones who most frequently contract an STD; gonorrhea is one example.



For instance, younger women are more likely than older ones to contract gonorrhea (Figure 6.5). Men are more likely to be carrying an infection than women.[45] Older people are more likely to be carriers of incurable viral STDs, many contracted when they were younger. By age 30, over 20 percent of Americans have contracted genital herpes,[46] but many may be unaware that they have been infected.[47] Genital warts may be even more prevalent by age 30.[48] By age 45, between four percent and 30 percent of Americans (depending on race) have been infected with hepatitis B,[49] and some of these people can transmit the infection to a sexual partner. By age 60, over one percent of all Americans have had syphilis.[50]

When a person is at high risk for acquiring an STD, contraceptive choice can alter the likelihood of infection. Condoms, when used correctly for every act of intercourse, can markedly reduce transmission of bacterial STDs and provide some protection against viruses such as those causing genital herpes, genital warts and AIDS.[51] Inconsistent condom use, however, offers little protection.[52]

A diaphragm also provides a certain degree of protection against bacterial STDs,[53] perhaps because it is usually used with spermicide. In laboratory tests, spermicides kill organisms responsible for gonorrhea, chlamydia and several viral infections, including HIV.[54] Studies of women at high risk of contracting an STD have produced evidence that spermicides and the sponge help reduce the incidence of these infections.[55] Similarly, a condom used with spermicide may be more effective at preventing STD transmission than a condom alone.[56]

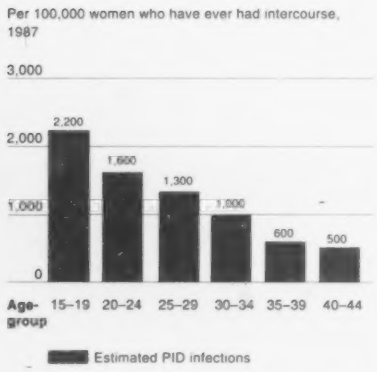
Periodic abstinence, withdrawal, sterilization, the IUD and oral contraceptives and other hormonal methods offer no protection against vaginal and cervical infections. While the pill aids in preventing the spread of infection into the upper genital tract (see chapter 7), its influence on lower genital tract infections is uncertain. Oral contraceptives may provide partial protection against vaginal infection with trichomonas.[57] Although the currently available, low-estrogen oral contraceptives seem to have little or no effect on the incidence of vaginal yeast infections[58] (which are sometimes sexually transmitted), women who used the earlier, high-dose pills had more such infections.[59] Lower genital tract infections with chlamydia, and perhaps also gonorrhea, appear to be more common among women using birth control pills than among other women, although it is not clear whether the pill actually alters a woman's likelihood of infection.[60] On the other hand, as mentioned, evidence suggests that the pill protects against symptomatic upper genital tract infections, one of the consequences of these diseases.

CHAPTER SEVEN

Upper Genital Tract Infection

FIGURE 7.1

The younger a woman is, the more likely she is to develop PID.



SUMMARY

Pelvic inflammatory disease (PID), an upper genital tract infection, occurs annually in about one percent of sexually active American women and is usually a consequence of sexually transmitted disease (STD). Upper genital tract infection can also develop after childbirth or abortion. Women in mutually monogamous relationships are unlikely to contract STDs and are therefore unlikely to experience an upper genital tract infection. Women who are not in mutually monogamous relationships are at high risk for STDs. Among such women, using barrier and spermicide methods and oral contraceptives will prevent large numbers of upper genital tract infections, while using periodic abstinence, the IUD or no method will add substantially to the risk of upper genital tract infection.

PID, a serious consequence of certain STDs, develops if an infection spreads into the upper genital tract—the uterus, fallopian tubes, ovaries or peritoneum.[61] Between 10 percent and 50 percent of women with gonorrhea will get PID if the infection is not treated.[62] Chlamydia is also likely to result in PID; other microorganisms can lead to it as well.

In its worst form, PID is an acute illness whose symptoms are pain and fever. However, the disease is often so mild that affected women do not recognize it, although it may flare up at any time and cause chronic pain and ill health.[63] Even in its mild form, PID can cause permanent scarring of the fallopian tubes or peritoneum, which may lead to ectopic pregnancy or tubal infertility.

An estimated 580,000 episodes of PID occur each year in the United States, resulting in 145,000 hospital admissions.[64] Approximately 1.2 percent of sexually active women aged 15–44 receive treatment for PID annually;[65] young women, who are more likely to have multiple partners, have the highest frequency of the disease (Figure 7.1). Virtually all cases of PID follow gonorrhea, chlamydia or other sexually acquired infections. Upper genital tract infections can also follow childbirth (puerperal infections) and both spontaneous and induced abortion (postabortal infections); often such infections are a consequence of acquiring an STD before or during the pregnancy.[66]

The various methods of birth control have different effects on the probability of developing an upper genital tract infection. A method can modify a woman's chances of getting an STD and, independently, change the likelihood of her developing PID if she does contract an STD. In addition, methods with high

failure rates increase the risk of upper genital tract infection by increasing the risk of pregnancy.

Barrier and spermicide methods reduce the incidence of PID to about one-half of that among women using no method.[67] Current knowledge is insufficient to allow us to assume that various barrier and spermicide methods differ in the protection they offer. Because of this, our calculations for the figures in this and the next two chapters combine the different barrier and spermicide methods.[68] Oral contraceptives also reduce the incidence of recognized PID by about half, compared with the incidence among women using no method.[69] One possible explanation is that the thickened mucus that develops in users of hormonal contraceptives acts as a physical barrier to ascending infection. Tubal sterilization is also thought to reduce the risk of PID.[70] On theoretical grounds, it is reasonable to assume that withdrawal, long-acting hormonal methods, progestin-containing IUDs and vasectomy might help prevent PID, but research to adequately test these effects has been insufficient.[71]

IUDs increase the chance of developing PID. At the time of insertion of an IUD, microorganisms in the cervix or vagina may enter the uterus. In the first month after insertion of an IUD, the likelihood of PID is approximately four times that among women using no method. However, the risk falls quickly as time passes.[72]

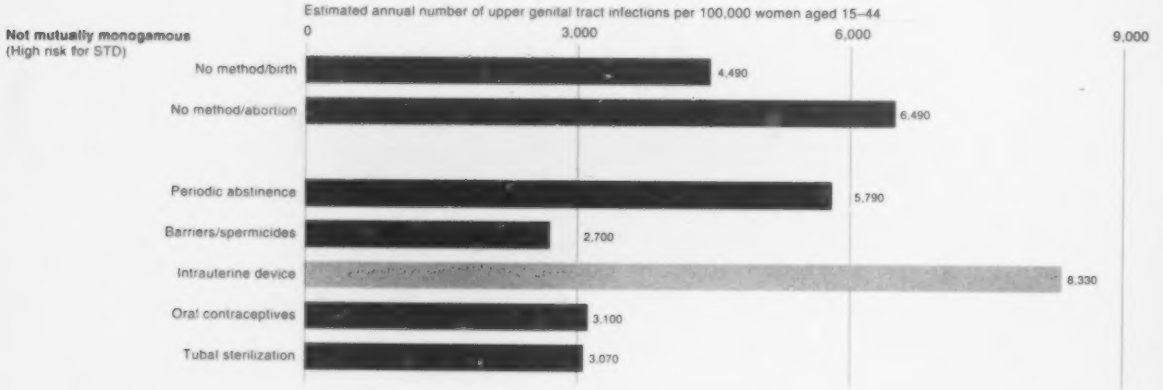
The first part of Figure 7.2 shows the estimated rates of upper genital tract infection among women in mutually monogamous relationships who use different birth control methods. Because these women are unlikely to acquire STDs, they have a low risk of upper genital tract infection; differences by method are therefore small. On the other hand, women who have more than one partner, or who are sexually involved with someone who has more than one partner, are at high risk for STD and upper genital tract infection. For these women, the birth control method selected becomes an important factor in the likelihood of developing upper genital tract infection, as is evident in the second part of Figure 7.2.

Women in mutually monogamous relationships who use barrier and spermicide methods, oral contraceptives or tubal sterilization are estimated to have at least 100 fewer annual episodes of upper genital tract infection per 100,000 than those using no method and giving birth (100–110 vs. 220 per 100,000). The absolute benefit of these methods is even greater among women in nonmonogamous relationships: Such women

FIGURE 7.2

Women in mutually monogamous relationships are unlikely to experience upper genital tract infections; contraceptive choice has a small effect on their risk of developing such infections.

Among women not in mutually monogamous relationships, birth control can greatly influence the risk of upper genital tract infection. No method, periodic abstinence and IUDs are poor choices for such women.



using barrier and spermicide methods will have an estimated 1,790 fewer annual episodes per 100,000 women (or nearly 2 per 100), and those using oral contraceptives will have 1,390 fewer per 100,000, than comparable women using no method and giving birth.

Although using periodic abstinence does not add to the risk of upper genital tract infection among women in mutually monogamous relationships, the method gives no protection against PID. Among women whose relationships are not mutually monogamous, the net result is that compared with those using no contraceptive and giving birth, users of periodic abstinence will have 1,300 more episodes of upper genital tract infection per 100,000 annually (more than one per 100 women); this is because those using periodic abstinence spend more time not pregnant, during which they are susceptible to an ascending infection from STDs. Compared with their counterparts using oral contraceptives and barrier and spermicide methods, they will have 2,690 and 3,090 more per 100,000, respectively (around three per 100 women).

IUD users are well protected against upper genital tract infection associated with childbirth or abortion because they experience few pregnancies. Among women in mutually monogamous relationships, the device contributes little to the risk of such infection. Figure 7.2 shows that this method is a riskier alternative for women in nonmonogamous relationships, however. Among those women, IUD users will have an estimated 3,840 more annual episodes of infection per 100,000 than women using no method and giving birth.

Among women who use no method, those who choose to terminate all unintended pregnancies with induced abortion face a higher risk of upper genital tract infection than those giving birth. This is not because abortion itself increases the risk of upper genital tract infection (in fact the risk is lower than that following birth), but because women who use no method and terminate unwanted pregnancies with abortion will spend less time being pregnant than women who carry unintended pregnancies to term and more time facing the negative health risks associated with not using a method.[73]

CHAPTER EIGHT

Ectopic Pregnancy

FIGURE 8.1

PID can lead to ectopic pregnancy; the more episodes of PID a woman has had, the more likely she is to have an ectopic pregnancy.

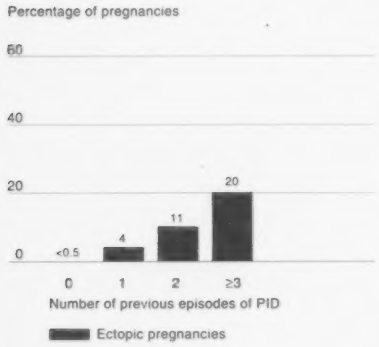
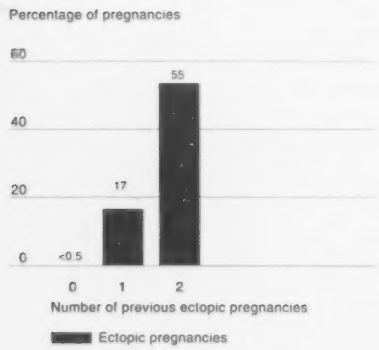


FIGURE 8.2

A woman who has had an ectopic pregnancy is at increased risk for future ectopic pregnancy.



SUMMARY

More than one percent of pregnancies are ectopic; many are a consequence of a previous tubal infection. Although pregnancies resulting from the failure of some contraceptives are more likely to be ectopic than are those resulting from the failure of others, use of any birth control method reduces the risk of ectopic pregnancy relative to that associated with use of no method. This benefit is most pronounced among women in relationships that are not mutually monogamous.

An ectopic pregnancy is one in which a fertilized egg implants in the fallopian tube (or, more rarely, in the ovary or other parts of the abdomen). Almost 88,000 ectopic pregnancies occurred in the United States in 1987; this represents roughly 170 ectopics for every 100,000 women aged 15–44 who have ever had intercourse and 1.4 percent of all pregnancies.[74] An undetected ectopic pregnancy can rupture the fallopian tube or ovary, leading to severe bleeding, a potentially life-threatening emergency. The risk that a pregnancy will be ectopic is increased in women who have had a sexually transmitted disease (STD),[75] pelvic inflammatory disease (PID) (Figure 8.1),[76] a previous ectopic pregnancy (Figure 8.2), tubal or pelvic surgery, or treatment for infertility, because these women are more likely than others to have changes or damage to the fallopian tubes.[77]

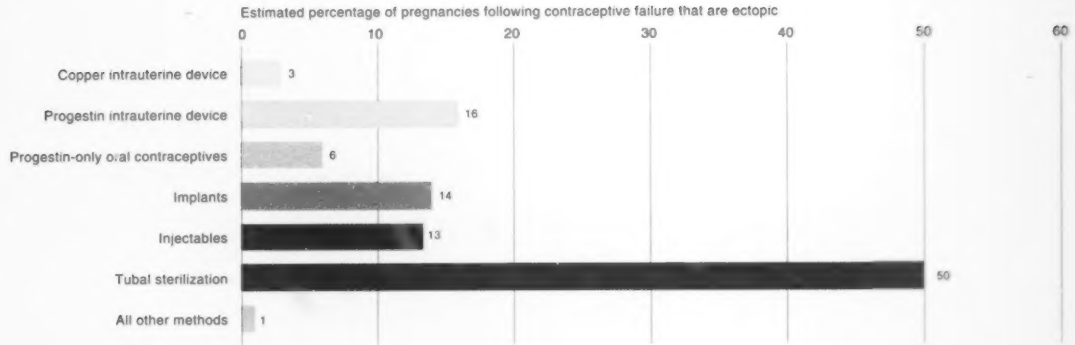
For a woman using contraceptives, the probability of having an ectopic pregnancy depends on four factors: how effective the method is at preventing pregnancy; the effect of the method on the risk that a pregnancy will be ectopic if a contraceptive failure occurs (Figure 8.3); whether the woman is likely to become infected with an STD; and whether the method influences her likelihood of developing an upper genital tract infection (e.g., PID).

Figure 8.4 shows estimates of the annual number of ectopic pregnancies per 100,000 users of different methods, depending on whether or not the women are in mutually monogamous relationships. The estimates are conservative since they are based on the assumption that no woman has had a tubal infection or an ectopic pregnancy before beginning use of the method.

Among women who have had the same number of pregnancies, those who have had induced abortions are at no greater risk for ectopic pregnancy than are those who have given birth.[78] In fact, when a woman has an unplanned pregnancy and faces the choice of whether to have an abortion or continue the pregnancy,

FIGURE 8.3

The failure of some contraceptive methods is more likely than the failure of others to lead to ectopic pregnancy.

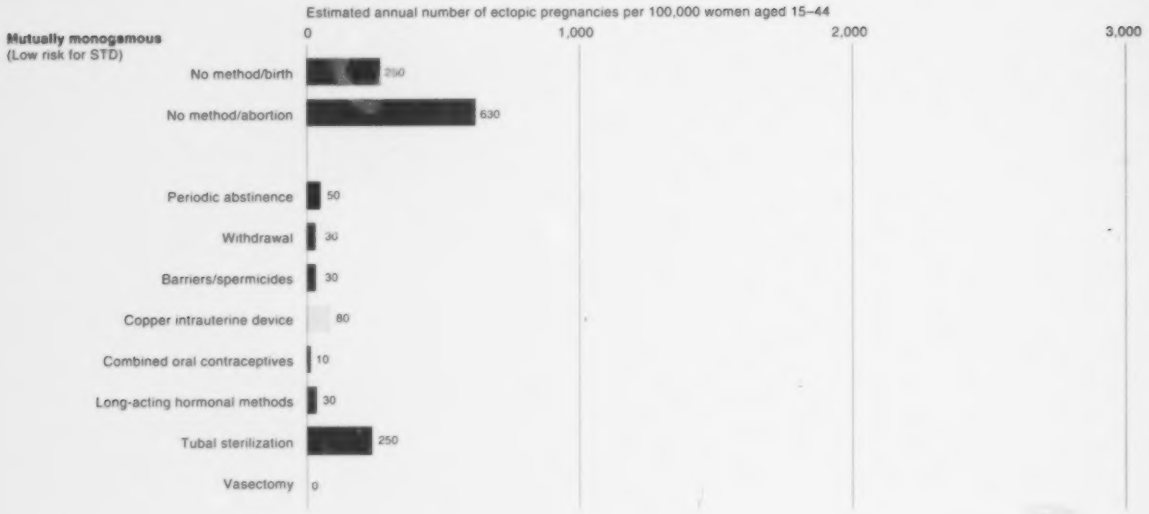


the risk of her next pregnancy being ectopic may be lower if she chooses abortion. This is because the risk of upper genital tract infection (one of the causes of ectopic pregnancy) may be lower after induced abortion than after childbirth. However, as Figure 8.4 shows, over a period of time, women using no method of birth control and choosing to terminate their pregnancies by abortion would have more ectopics than those using no method and giving birth. The reason for this is that women choosing abortion could become pregnant again (and be at risk for an ectopic pregnancy again) within a short time, while women giving birth would be "protected" against further pregnancies, and further ectopics, during the months they are pregnant and for a short time afterward.

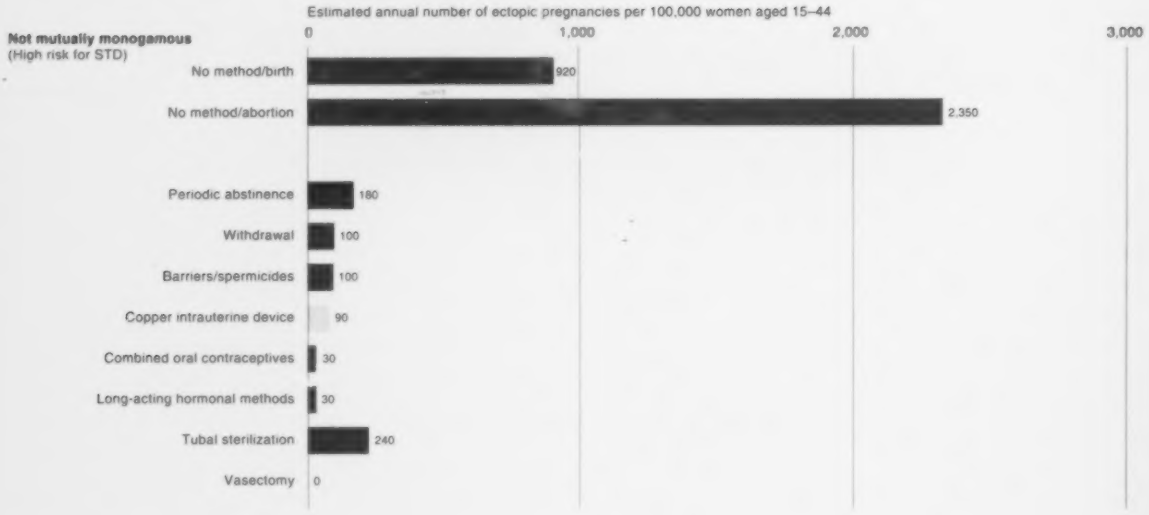
Helping to prevent ectopic pregnancies is a side benefit of all methods of birth control. The absolute benefit is greatest for women in relationships that are not mutually monogamous because of their higher risk of STD and tubal infection. Thus, while birth control prevents an estimated 30–280 annual ectopics per 100,000 women in mutually monogamous relationships (compared with the incidence among those using no method and giv-

FIGURE 8.4

Women using no contraceptive method are the most likely to have an ectopic pregnancy. However, ectopic pregnancies are much less common among women who are at low risk for STD . . .



. . . than they are among women who are at high risk for STD.



ing birth), it prevents an estimated 680–920 per 100,000 in nonmonogamous relationships (compared with the incidence among those using no method and giving birth).

Striking differences emerge in the incidence of ectopic pregnancy between women relying on the two permanent contraceptive methods—tubal sterilization and vasectomy. While both methods are highly effective in preventing pregnancy, if a pregnancy does occur, the chance that it will be ectopic is not affected by vasectomy but is very high among women who have undergone tubal sterilization (Figure 8.3)[79] Nevertheless, because of their extremely low risk of contraceptive failure, 100,000 women who have undergone tubal sterilization will have fewer ectopic pregnancies than an equal number of women using no contraceptive (Figure 8.4).

The incidence of ectopic pregnancy differs little between women in mutually monogamous and nonmonogamous relationships who use long-acting hormonal methods, tubal sterilization or the IUD. This is because the likelihood of users becoming pregnant is so low (see Figure 5.3).

CHAPTER NINE

Tubal Infertility

FIGURE 9.1

Tubal infertility is more common among women who have had PID.

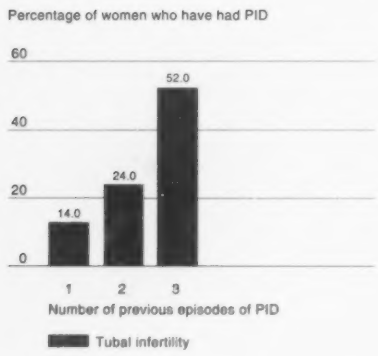
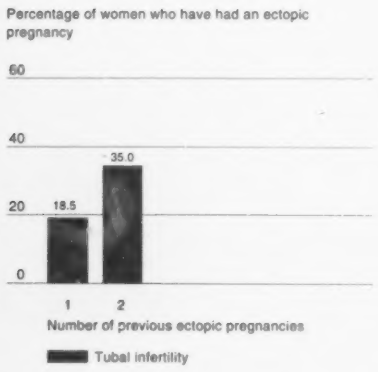


FIGURE 9.2

Tubal infertility can result from ectopic pregnancies.



SUMMARY

Upper genital tract infection and ectopic pregnancy can lead to tubal infertility; therefore, birth control methods and other factors that change the risk of infection or ectopic pregnancy can affect the risk of infertility. Women in relationships that are not mutually monogamous or in which one of the partners carries a sexually transmitted disease (STD) are at greatly increased risk of tubal infertility, especially if they use the IUD, periodic abstinence or no method. Barrier and spermicide methods will help to preserve these women's potential to bear children in the future. Women in mutually monogamous relationships in which neither partner has an STD have a low risk of tubal infertility; contraceptive choices will have little influence on their future fertility.

Most couples having intercourse without using a contraceptive can expect the woman to become pregnant within a short time. About 85 percent of women trying to become pregnant will conceive within a year.[80] After two years, however, the likelihood of conception falls to around 1–3 percent per cycle.[81] Whereas chance may explain why some couples do not conceive soon when having intercourse with no contraceptive, the longer the time that has elapsed, the greater the likelihood that the couple is infertile. Of U.S. women aged 15–44 surveyed in 1988, six percent (an estimated 3.5 million) reported that they or their partner were unable to have a child (see Figure 2.1).

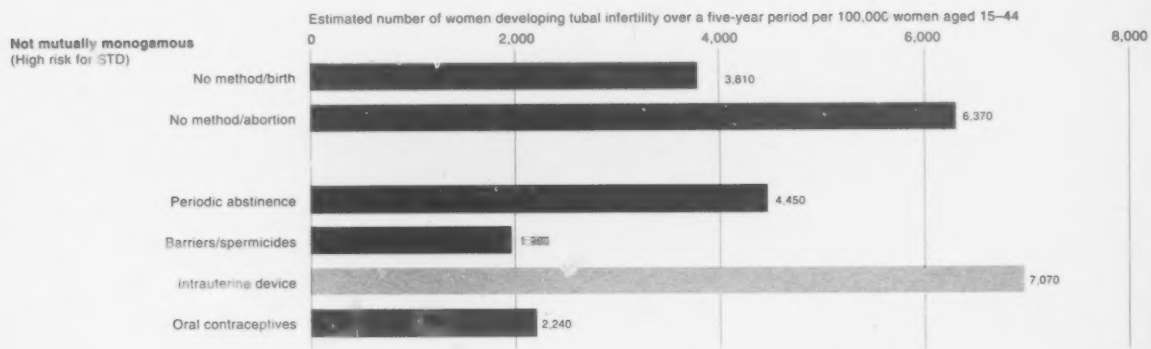
The older a woman is, the more likely she or her partner is to be infertile (see Figure 2.3). One reason is that as time passes, women are more likely to acquire infections that lead to blockage of the fallopian tubes, that is, tubal infertility. Another reason is that time may be needed to discover that a couple is infertile; those using contraceptives will not necessarily know whether they are infertile until they stop and try to conceive. In addition, a woman's reproductive life has a limited time span; with increasing age, especially in the late 30s and 40s, menstrual cycles become less regular and ovulation less frequent. As a woman gets older, if she does become pregnant, her chance of having a spontaneous abortion is increased.

Infertility can result from anomalies in the man alone (about 25 percent of couples), the woman alone (35 percent), or both the man and the woman (24 percent), or it can be unexplained (16 percent).[82] In women, one of the most common causes of infertility is blockage of the fallopian tubes.[83] Pelvic inflammatory disease (PID) and other upper genital tract infections

FIGURE 9.3

Among women in mutually monogamous relationships, tubal infertility from infection is rare. This is true regardless of choice of contraceptive method.

Among women not in mutually monogamous relationships, by contrast, tubal infertility is much more common. Barrier and spermicide methods offer these women the greatest protection.



are common causes of tubal infertility (Figure 9.1);[84] ectopic pregnancy (Figure 9.2) and pelvic surgery, such as that for appendicitis or ovarian cysts, are others.[85]

Because contraceptives can influence the likelihood both of upper genital tract infection and of ectopic pregnancy, they also affect—indirectly—a woman's chances of developing tubal infertility. There is no indication, however, that any methods cause tubal infertility directly. Figure 9.3 shows the estimated number who will become infertile during five years of use of each method

as a result of damage to their fallopian tubes caused by upper genital tract infections and ectopic pregnancy. Tubal infertility is many times more common among women at high risk of infection than among those at low risk (women in nonmonogamous relationships vs. those in monogamous relationships). Although the likelihood of developing tubal infertility is very low among mutually monogamous couples in which neither partner has an STD, all women have some risk, regardless of their contraceptive choice.

In mutually monogamous relationships, women using no method of birth control are the most likely to develop blockage of the tubes. Although one abortion is no more likely to be followed by tubal infertility than one birth,[86] if women were to use no method of contraception over a five-year period and terminate all pregnancies by abortion, they would have a higher incidence of tubal infertility than if they were to choose to give birth. This is because they would conceive more often and therefore have more opportunities for ectopic pregnancies (see chapter 8) and upper genital tract infections (see chapter 7).

All methods of contraception help to prevent tubal infertility among women in mutually monogamous relationships. As demonstrated in Figure 9.3, an estimated 400–740 cases will develop per 100,000 such women using no method over a five-year period, but the various methods of birth control will prevent 120–320 cases per 100,000 users, compared with nonusers giving birth. The IUD offers the least protection against tubal infertility, but the difference between it and other methods is small among women in mutually monogamous relationships.

By contrast, method choice has a substantial effect on the likelihood of developing tubal infertility among women who are in relationships that are not mutually monogamous. An expected 3,810–6,370 new cases of tubal infertility will develop during a five-year period per 100,000 such women using no contraceptive. Barrier and spermicide methods will prevent 1,830–4,390 cases per 100,000 users, compared with those using no method and giving birth. Oral contraceptives, according to our estimates, will also prevent tubal infertility, though to a lesser extent than barrier and spermicide methods.[87]

Compared with users of the pill and barrier and spermicide methods, women relying on periodic abstinence are at a greatly increased risk of tubal infertility if they are in a relationship that is not mutually monogamous. Those relying on periodic abstinence will also have more cases of tubal infertility per 100,000 over a five-year period than women who do not use a method and give birth, because they will have had more cases of PID (see chapter 7).

Likewise, the IUD is not a good choice for women involved in nonmonogamous relationships. Because such women are at high risk for STD and upper genital tract infection, using the IUD adds greatly to their risk of tubal infertility.[88] Although IUD users in mutually monogamous relationships will not be protected against upper genital tract infections to the same extent as users of barrier and spermicide methods or oral contraceptives, they will be less likely to experience tubal infertility than those using no method.

Health Effects of Contraception

CHAPTER TEN

Cancer

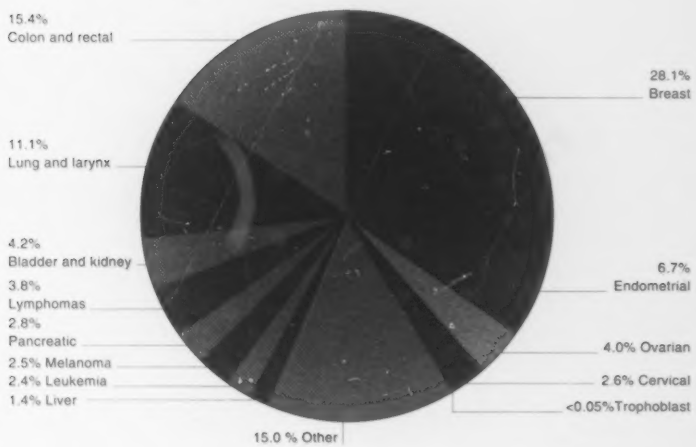
SUMMARY

Use of some birth control methods can benefit a woman's health by reducing the incidence of certain cancers, most of which would occur in later life, long after the need for contraception has passed. Barrier and spermicide contraceptives reduce the chance of developing cancer of the cervix; the longer they are used, the lower the risk. Oral contraceptives reduce women's risk of ovarian and endometrial cancer; this benefit affects women soon after starting pill use, becomes stronger with greater duration of use and persists for many years after use is discontinued.

The relationship of oral contraceptives to breast cancer is not yet completely clear. Through age 54, breast cancer is equally common among women who have and have not ever used the pill. Some studies have suggested, however, that women who used the

FIGURE 10.1

About two-fifths of all cancers among women occur in the reproductive system; breast cancer is the most common.



Cancers diagnosed among women of all ages, 1989
(505,000)

pill for prolonged periods in their teens or early 20s are more likely than those who did not to be diagnosed with breast cancer in their 30s and early 40s. Evidence also suggests that as such women become older, they may be less likely to develop breast cancer than women who never used the pill.

Each year, cancers are diagnosed in more than a half a million American women. About two-fifths of these are malignancies of the reproductive organs (Figure 10.1); breast cancer contributes the highest proportion, accounting for over one-quarter of all cancers among women. In this chapter, we focus on cancers that pregnancy influences and that contraceptive use may affect, either beneficially or adversely.

We have estimated the incidence of the various cancers in terms of diagnosed cases, because there is no way to estimate those that go undetected. Cancers are diagnosed only after they have been growing for some time, often for several years. Consequently, birth control methods that alter the risk of developing cancer affect a woman's health in the future, often years after the need for contraception has passed.

Research done on potential effects of contraceptives on cancers has usually focused not on the effects of current use, but on the impact of ever having used the method and on possible differences according to duration of use. Similarly, figures in this chapter show estimates either for ever-users or for long-term users. In the United States, for example, women who have ever used oral contraceptives have done so on average for 4–5 years.[89] In presenting information on long-term users, we have arbitrarily chosen to show estimates for women who have used the method for 10 or more years, or from age 15 if they are less than 25 years old. Women who have used the method for shorter periods can expect similar but reduced levels of effects.

The Pill and Cancers

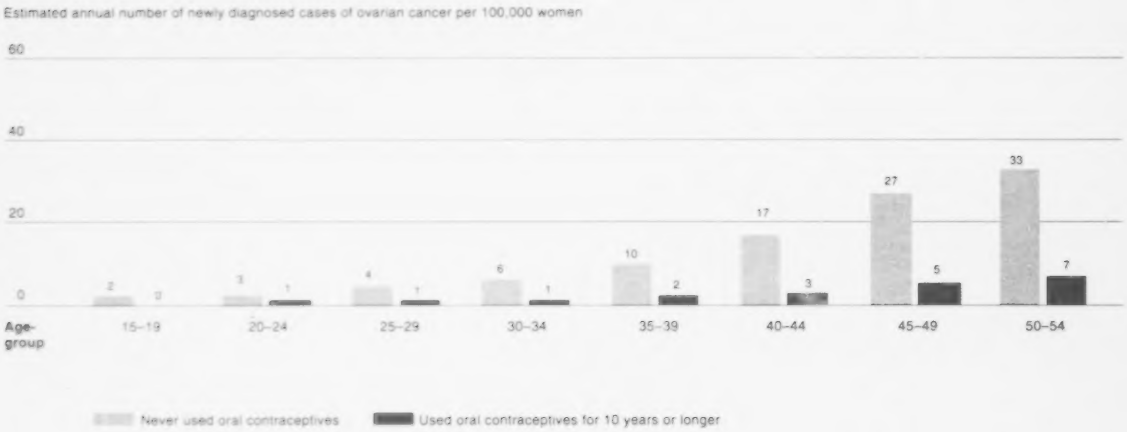
The pill helps to protect against two kinds of reproductive cancers in women—ovarian and endometrial. Women using the pill can confidently expect that their risk of developing these cancers will be lower than that of women who have never used oral contraceptives, even after they have discontinued use.

Ovarian Cancer

Ovarian cancer is diagnosed in approximately two per 100,000 U.S. women aged 15–24 each year,[90] and for women at these ages,

FIGURE 10.2

Use of oral contraceptives greatly reduces the incidence of ovarian cancer; the number of cases prevented—the difference between the number among users and the number among nonusers—is greatest among older women.



the disease is the most common reproductive cancer. As is true of most cancers, the annual incidence rises with age; it reaches nearly 12 diagnosed cases per 100,000 women aged 40–44. In most women with ovarian cancer, the disease has spread by the time the diagnosis is made, so treatment is difficult; within five years after diagnosis, about 62 percent of women will die from it.[91]

Birth control pills protect strongly against ovarian cancer. Women who have ever used the pill have a 40 percent lower risk of developing the disease than women who have never used it.[92] A decreased risk of the disease is detectable within a few months of starting the pill. The likelihood of being diagnosed with ovarian cancer is reduced by 30 percent among those who have used the pill for four years or less, by 60 percent among those who have used it 5–11 years and by 80 percent after 12 or more years of use (i.e., to an incidence of about one-fifth that in women who have never used oral contraceptives).[93] Women who start using the pill at an early age and continue for a long period may be even more strongly protected.[94]

Figure 10.2 shows estimates of the incidence of ovarian cancer in long-term users of oral contraceptives (those who have used the pill for 10 years or more, or, if they are under age 25, from age 15) compared with women who have never used the pill. The long-term users would have an estimated 2–3 fewer cases diagnosed per 100,000 each year in their 20s, increasing to 26 fewer per 100,000 aged 50–54. By age 55, 100,000 women who began oral contraceptive use by age 20 and used oral contraceptives for 10 years or more will have about 400 fewer of these cancers than 100,000 women who have never used the pill. The

average woman who has ever used the pill will have reduced her chances of being diagnosed with ovarian cancer by 200 per 100,000 by the time she reaches her 55th birthday.[95] Oral contraceptive use protects against ovarian cancer for at least 15 years after use is discontinued,[96] but the pill has not been available long enough to determine whether this benefit persists for the rest of a woman's life. Ovarian cancer occurs most frequently in women who have borne few or no children; the pill offers them greater protection against the disease than it does women who have had many births.[97]

Endometrial Cancer

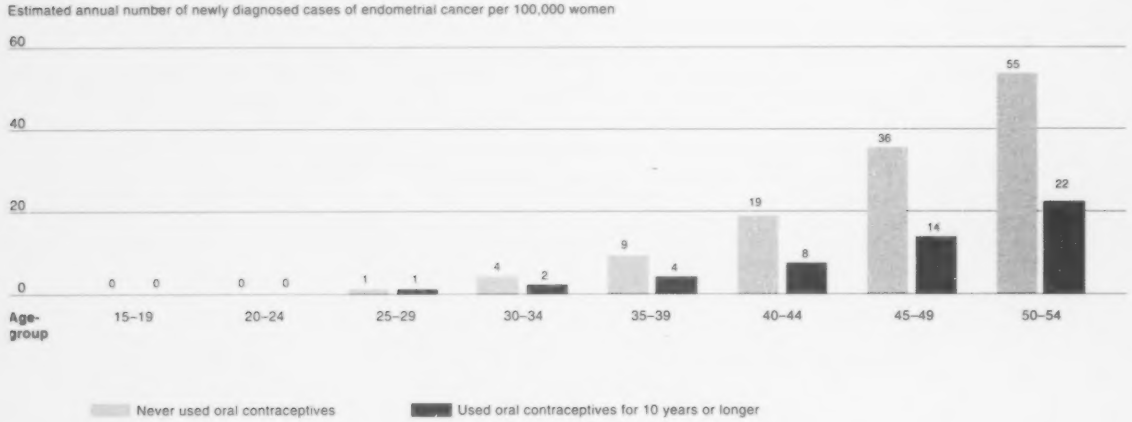
In the United States, the incidence of endometrial cancer increases from about 0.1 per 100,000 women aged 20–24 to 12 or more among those aged 40–44.[98] Repeated pregnancies protect against endometrial cancer.[99] A woman's weight also strongly affects risk; the disease is rare in slender women and much more common than average in those who are overweight.[100]

Oral contraceptives help protect against endometrial cancer. The risk of this cancer among women who have used the pill for at least two years is about 40 percent less than that among women who have never used it; those who have used the pill for four or more years have a 60 percent lower risk than never-users.[101] Women who have ever used the pill will have had about 300 fewer diagnosed cases of endometrial cancer per 100,000 before age 55. Former pill users continue to have a lower incidence of endometrial cancer for at least 15 years after they stop relying on the method, but whether the protection continues for the rest of their lives remains an open question.[102]

Figure 10.3 shows the estimated incidence of endometrial cancer in women who have used oral contraceptives for at least 10 years and in women who have never used oral contraceptives. The number of cancers prevented is greatest later in life: Each year, 22–33 fewer diagnoses of endometrial cancer will be made per 100,000 women aged 45–54 as a consequence of long-term use of oral contraceptives during their childbearing years. Compared with women who have never used oral contraceptives, those who have used the pill for 10 years or more will have prevented about 365 cases of endometrial cancer per 100,000 by age 55, regardless of the age at which use was started.

FIGURE 10.3

Use of oral contraceptives reduces the risk of endometrial cancer; the number of cases prevented—the difference between the number among users and the number among nonusers—is greatest among older women.



Breast Cancer

Breast cancer is the most common malignancy that affects American women. It occurs in about 0.1 per 100,000 women aged 15–19 and one per 100,000 aged 20–24 each year. The incidence in the age-group 40–44 is 120 per 100,000; among those 50–54, it is 200 per 100,000.[103] More than one percent of American women will receive a diagnosis of breast cancer before age 45, as will nearly three percent by age 55 and approximately 10 percent by age 75.[104] Although breast cancer is less common than ovarian and cervical cancer among women in their early 20s, it is the most common reproductive cancer by age 30 and remains so at all subsequent ages.

Childbearing affects the risk of breast cancer: The later a woman bears her first child, and the fewer children she has, the greater the risk. Because the timing of a woman's first birth influences her risk of breast cancer, women who use contraceptives effectively to postpone their first birth will be more likely to develop breast cancer than women who have births early in life. But their late age at first childbearing, not the contraceptive use, will most likely be the factor that elevates the risk of breast cancer.

Many researchers have tried to determine whether oral contraceptives directly alter a woman's risk of breast cancer. One consistent finding from studies done so far is that the risk of being diagnosed with breast cancer by age 55 does not differ between women who have and have not used the pill when all age-groups are considered together.[105] Furthermore, the studies clearly show that women who first used the pill at age 25 or later have the same incidence of breast cancer as women who never used it.[106] This is true regardless of duration of pill use. Uncer-

tainties and debates still exist regarding the effects of use of the pill by younger women.

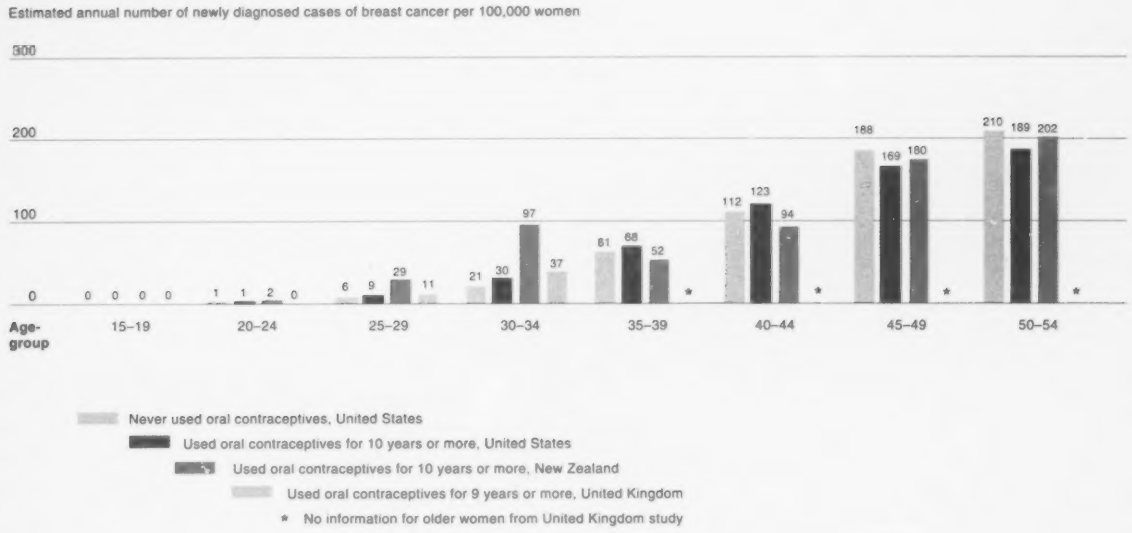
When birth control pills first became available, the average user was a married woman who already had children. Until recently, research on breast cancer among former pill users reflected the experience of these women, many of whom were aged 25 or older when they began use. Only later, in the early 1970s, was the typical user a younger woman, often without children.[107] Recent research has tried to focus more on these younger women, who typically started taking the pill prior to their first birth, perhaps in their teens or early 20s. Results from these studies vary.

The federal Centers for Disease Control conducted one of the largest and most reliable studies—one of almost 10,000 American women, called the Cancer and Steroid Hormone (CASH) study. Results of a recent analysis of the CASH study indicated that at age 35 or younger, women who had used the pill were 1.4 times more likely to have been diagnosed with breast cancer than those who had never used oral contraceptives. The rate of diagnosis in ever-users aged 35–44 was about 1.1 times that in comparable never-users; at older ages, it declined to 0.9 times the rate in never-users.[108] In other words, current or former pill use was associated with a slightly raised likelihood of breast cancer diagnosis at a young age—a time when the disease is relatively rare—but it is associated with a decreased likelihood among older women, in whom the disease is much more common.

The CASH study investigated an effect of duration of use and found that among women aged 20–34, the risk of being diagnosed with breast cancer rose with duration of pill use to a maximum at 4–5 years of use and then decreased somewhat. At ages 35–44, the risk of being diagnosed with breast cancer peaked at 8–9 years of use and decreased thereafter. At ages 45–54, there was no effect of duration of pill use. None of these trends in duration of use was statistically significant. Rather, the CASH study showed that the important factor in the risk of being diagnosed with breast cancer among pill users was not how long they had used the pill, but how long it had been since first use (regardless of how long they had continued to use it).[109] At ages 20–34, the risk of being diagnosed with breast cancer was highest at 12–13 years since first pill use; at ages 35–44 and 45–54, the risk of being diagnosed with breast cancer decreased significantly the longer the time that had elapsed since the woman first started using the pill.

FIGURE 10.4

Studies in three countries show that long-term pill users under age 35 are more likely to have breast cancer diagnosed than never-users of the same age. Among women 45–54, the relationship is reversed: Pill users are less likely to be diagnosed with breast cancer.



Studies in other countries have shown slightly different results, though some are consistent with these U.S. findings.[110] Researchers in New Zealand also found no significant effect of duration of use. Breast cancer was detected most often among women under age 35 who had used the pill for 10 or more years, but among women aged 35–49 who had used oral contraceptives for an equally prolonged period, the risk was lower than in never-users.[111] A study in the United Kingdom looked only at women aged 35 and younger; it found that the risk of being diagnosed with breast cancer increased significantly with longer durations of pill use.[112]

Figure 10.4 shows estimates of breast cancer incidence by age calculated from each of these three studies, comparing long-term pill users and never-users. Estimates for never-users are based on information for U.S. women from the CASH study. According to the CASH results, women aged 25–29 who have used the pill for at least 10 years will have three breast cancer diagnoses more per 100,000 each year than women who have never used this method. Current or former long-term users in their 30s can expect 7–9 more cases per 100,000 per year, and those in their early 40s can expect 11 more per 100,000. In their late 40s and early 50s, however, women who have used the pill for 10 years or longer will experience 19–21 fewer annual cases of breast cancer per 100,000.

The New Zealand study predicts that women who have used the pill for at least 10 years will have more cases of breast cancer at ages 25–34 (Figure 10.4). This study also suggests that former pill users will have fewer cases each year at ages 35–54. According to the study done in the United Kingdom, long-term users might have 5–16 more annual cases per 100,000 women aged 25–34. The British group did not investigate older women.

Other research groups also have studied whether oral contraceptives affect breast cancer. One study by researchers in Scandinavia focused on women under 45 and found that the risk of the disease rose with duration of pill use.[113] On the other hand, a large international study by the World Health Organization suggested that current pill use may increase the risk of breast cancer diagnosis, but that duration of use may be unimportant.[114] A study of nurses in the United States has yielded similar findings.[115] Most other researchers have not been able to investigate prolonged use of the pill or extended use by very young women. All of the research published up until now relates to effects of older, higher dose pills. Effects of the newer, low-dose pills are unknown.

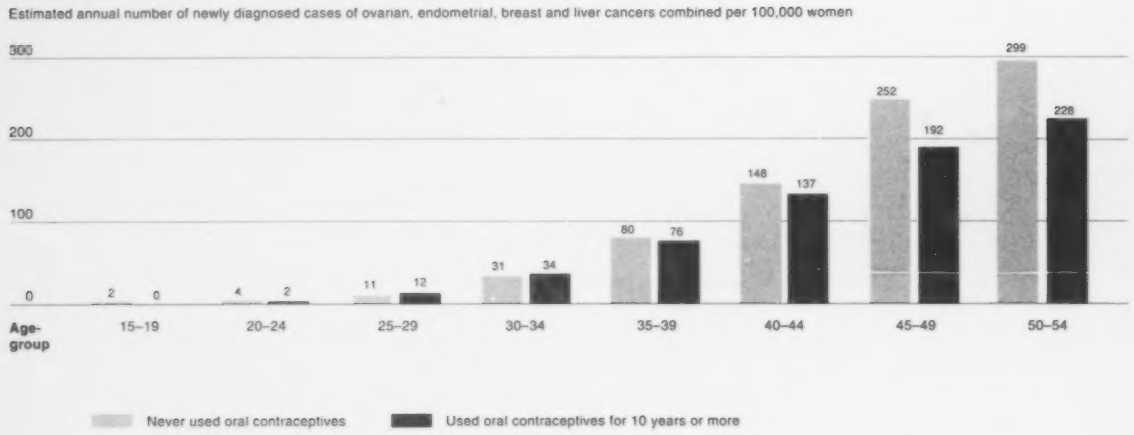
At the moment, the findings that are probably most relevant to American women are those from the CASH study. More research is obviously needed to clarify whether results from some studies are misleading, or to make sense of the contradictions that have been found.[116] A number of hypotheses could explain these findings. One is that pill users are screened more often than nonusers—either by breast self-examination or by medical professionals—and that breast cancers are thus detected earlier in them.[117] Another is that the hormones in oral contraceptives may accelerate the growth of an undiagnosed breast cancer (or of certain varieties of breast cancer), but do not "initiate" the cancer, or cause it to develop in the first place. This effect would be consistent with the way pregnancy temporarily increases the risk of breast cancer.[118] A third suggestion is that women who use oral contraceptives for prolonged periods may have health characteristics that themselves affect the risk of breast cancer.[119]

Other, Rare Cancers

A number of studies have found that the older, higher dose oral contraceptives had a positive relationship with liver cancer, especially when the pills were taken for many years;[120] whether modern, low-dose pills also have an effect on liver cancer is unknown.[121] Because liver cancer is rare—less than one case per 100,000 women each year[122]—any increase in the incidence among women

FIGURE 10.5

Women who have used oral contraceptives for a long time are less likely at most ages to be diagnosed with reproductive cancers than women who have never used the pill. The protection gained from oral contraceptive use is greatest at older ages.



attributable to pill use would be extremely small. For instance, among a group of 100,000 U.S. women under 35 who used oral contraceptives for 10 years or more—or since they were age 15—we might expect less than one additional case of the disease each year; among 100,000 aged 35–44, about two additional cases each year.[123]

Precursors of liver cancer are cirrhosis of the liver, alcohol abuse and hepatitis B infection. The fact that some cases of hepatitis B are acquired by sexual transmission[124] suggests that condoms should offer some protection, but there is no proof that they do.

Melanoma, another cancer, was once suspected of being associated with pill use, but several research groups have discredited any relationship.[125] Likewise, research has discounted an association between current or former use of oral contraceptives and gallbladder cancer.[126]

Balancing the Risks and Benefits

How does the certain protection against ovarian and endometrial cancer that a woman gains from using the pill trade off against the possible additional risk of other cancers? Figure 10.5 shows the estimated effect of long-term (10 or more years, or from age 15 for women under age 25) oral contraceptive use on the total number of diagnosed cases of cancers of the ovary, endometrium, breast and liver. These estimates combine information from Figures 10.2–10.4 (using the U.S. data) and data on risks of liver cancer presented above.

When all cases of ovarian, endometrial, breast and liver cancers before age 25 are totaled, the number of cases of cancer

among women who have used the pill since age 15 will be less than among women who have never used oral contraceptives. This difference between users and nonusers results from the pill's protection against ovarian cancer. At ages 25–29, long-term pill users will have one cancer more each year per 100,000, and at ages 30–34 they will have three more per 100,000 each year than among an equal number of women who have never used the pill, because of added cases of breast cancer. From age 35 on, the reduced likelihood of ovarian and endometrial cancer among those who have used oral contraceptives for at least 10 years will more than balance the estimated additional cases of breast cancer at ages 35–44. The differential advantage among pill users—that is, the difference in the estimated incidence of cancers diagnosed each year—rises with age.

Contraceptive Methods and Cervical Cancer

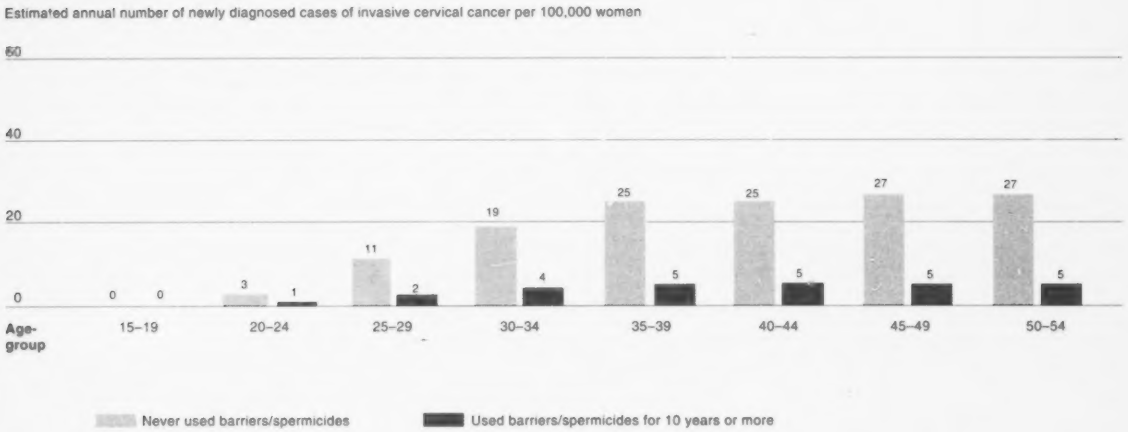
Invasive cancer of the cervix is diagnosed each year in 0.2 per 100,000 U.S. women aged 20–24.[127] Its incidence rises to 4–5 per 100,000 at ages 44 and up.[128]

Cervical cancer appears to be caused, in part, by certain strains of human papillomavirus (HPV), a sexually transmitted disease, or by the interaction of HPV with other infections.[129] As is the case with sexually transmitted diseases (STDs) (see chapter 6), the risk of cervical cancer is strongly related to the number of sexual contacts a woman[130] or her partner[131] has had. Repeated childbearing appears to add to the risk of this cancer,[132] as does smoking.[133] Pap smears can detect many early cases of invasive cervical cancer, as well as its precursors, such as cervical dysplasia and intraepithelial neoplasia. Regular screening, especially of women at increased risk, and treatment of these precursor conditions can avert most cases of invasive cervical cancer and prevent deaths from it.[134]

Barrier contraceptives help protect against cervical cancer and its precursors. Women who have ever used a diaphragm, condom or spermicide are about half as likely to have cervical cancer diagnosed as women who have never used these methods. Before they reach age 55, 100,000 American women who have ever used one of these methods will have an estimated 340 cases of cervical cancer diagnosed, compared with twice as many cases among women who have never used a barrier or spermicide method (while data on the effects of the cap and the sponge are not available, it is assumed that they are similar).[135] The longer a woman has relied on barrier or spermicide methods, the greater the protection from cervical cancer. Compared with women who have never used

FIGURE 10.6

Barrier and spermicide contraceptives reduce the risk of cervical cancer. Their effect increases with age.



barrier or spermicide methods, those who have used them for 10 years or more will have an estimated 15 fewer cases of invasive cervical cancer diagnosed each year per 100,000 women aged 30–34, and 20–22 fewer per 100,000 older women (Figure 10.6). By age 55, women who have used barrier and spermicide methods for at least 10 years before age 30 will have about 500 fewer cases of cervical cancer per 100,000 women than those who never used them before age 30.

These estimates are based on the average U.S. woman's risk of cervical cancer, with no adjustment for differences in exposure to STDs. Women in nonmonogamous relationships are at greatly increased risk of cervical cancer. Thus, just as barrier and spermicide contraceptives have a greater benefit against upper genital tract infection and tubal infertility for women in nonmonogamous relationships than for those in mutually monogamous relationships, they will have a greater benefit for these same women in preventing cervical cancer.

Periodic abstinence, oral contraceptives and tubal sterilization offer no protection against invasive cervical cancer, although vasectomy may help prevent it.[136] The complete effect of oral contraceptives on cervical cancer is uncertain.[137] Several recent studies have found no differences in the risk of cervical cancer between women who have and have not ever used the pill,[138] although research conducted during the 1970s found that invasive cervical cancer was detected more frequently among those who had ever used the pill.[139] Since, unlike the earlier studies, the most recent ones have tended to take into account factors known to increase the risk of cervical cancer, such as the number of sexual partners, smoking and use of barrier and spermicide methods, they may be more accurate.[140]

Choriocarcinoma and Gestational Trophoblastic Disease

Choriocarcinoma is a rare cancer originating in the trophoblast—the part of the embryo that forms the placenta—or in tissues that resemble it. Most choriocarcinomas follow a molar pregnancy—an abnormality of development of the trophoblast in which there is no fetus and which usually results in a spontaneous abortion.[141] About 6,000 molar pregnancies occur each year in the United States, representing about one per 1,000 pregnancies.[142] Women having them are at high risk, albeit for a short period, of potentially fatal complications, including bleeding, hypertension, pulmonary embolism and stroke. After a molar pregnancy, women need vigilant medical attention, including repeated pregnancy tests for a year or more to make sure that the trophoblastic tissue disappears. In at least 15 percent of cases in the United States, the tests indicate that the disease is persisting and the women are started on chemotherapy.[143] Such screening and therapy prevent almost all actual trophoblastic cancers. Even if a malignancy does develop, however, it is likely to respond well to treatment.

To the degree that they reduce the risk of pregnancy, all contraceptive methods likewise reduce the risk of gestational trophoblastic disease. Thus, the more effective the method is as a contraceptive, the greater the protection it provides against the disease. Each year, among 100,000 women aged 15–39 who use no method, those deciding to give birth will experience 19 episodes of molar pregnancy necessitating chemotherapy,[144] and those choosing induced abortion will have 30 such episodes. Abortion does not cause trophoblastic disease, but a group of women using no method and choosing abortion will have more pregnancies in a year than a group choosing to give birth; the former will therefore be at higher risk for the disease. Women relying on periodic abstinence, withdrawal or barrier and spermicide methods will experience about three molar pregnancies needing chemotherapy per 100,000 annually; those using IUDs or oral contraceptives will have about one per 100,000 each year.

Among women aged 40–44, the frequency of cases requiring chemotherapy will be about 103–144 per 100,000 women using no method. While about 12 cases will occur each year per 100,000 women aged 40–44 relying on periodic abstinence, withdrawal or barrier and spermicide methods, the incidence among IUD users and among pill users will be about three cases per 100,000. Women relying on long-acting hormonal methods or sterilization will experience virtually no molar pregnancies, because they have very few pregnancies.

Other Contraceptives and Cancer

Other methods of birth control may influence a woman's risk of cancer either by a direct effect of the method or by changing the number of pregnancies she has or their timing. There has been little systematic research on methods other than oral contraceptives and barrier and spermicide methods, however, and for this reason, we have not tried to estimate what their effects would be, or how using no method would change a woman's risk of cancer, compared with any method.

Repeated births increase the risk of cervical[145] and liver cancers,[146] but decrease the likelihood of ovarian[147] and endometrial[148] cancers. Some of these effects may be due to pregnancies rather than births, but most researchers have not clearly separated the two; it is therefore not clear whether women who use no method and choose to terminate all pregnancies would have the same future risk of cancers of the reproductive system as women who choose to give birth. The timing of births also influences future cancer risk. Early childbearing protects against breast cancer (the earlier, the lower the risk),[149] but for a few years after a pregnancy a woman's risk of being diagnosed with breast cancer is raised.[150] Women who have breastfed are less likely to be diagnosed with breast cancer before age 55; the longer they have done so the lower the risk.[151] Lactation may have a similar effect on ovarian and endometrial cancer.[152]

Contraceptives, because they influence a woman's timing, spacing and total number of pregnancies and births, can indirectly affect her risk of cancer. Apart from barrier and spermicide methods and hormonal contraceptives, few methods are suspected of having any direct effect on cancer risk. There has been little systematic research, however.

So far as is known, periodic abstinence and the copper IUD have no direct effect on cancer risk, and there is no theoretical reason why they should. The same is true of withdrawal, except that some scientists believe that women whose partners use this method should have a lower risk of cervical cancer; one hypothesis is that substances in seminal fluid contribute to the development of this cancer.[153] However, the risk of cervical cancer has never been reported in relation to withdrawal. According to a similar hypothesis, women whose husbands have had a vasectomy might be at a lowered risk for cervical cancer,[154] but, again, there is no evidence whether they are or not.

Women who have had a tubal sterilization appear to have a lowered risk of ovarian cancer.[155] The reason for this is un-

FIGURE 10.7

Contraceptive methods can have different effects on various types of cancer; in general, the effects are protective.

Type of contraceptive	Type of cancer					
	Cervical	*Ovarian*	*Endometrial*	*Breast*	*Liver*	*Trophoblast*
No method/birth	repeated births increase risk	repeated births decrease risk	repeated births decrease risk	early age at first birth protects; first birth at older ages increases risk; risk may decrease as parity increases	risk probably increases as parity increases	frequent pregnancy increases risk
No method/abortion	effect not known	effect not known	effect not known	fewer, later births may increase risk	effect not known	frequent pregnancy increases risk
Periodic abstinence	offers no protection	offers no protection	offers no protection	offers no protection	offers no protection	offers protection by preventing pregnancy
Withdrawal	theoretically offers partial protection, but no evidence available	offers no protection	offers no protection	offers no protection	offers no protection	offers protection by preventing pregnancy
Barrier and spermicide methods	offer strong protection, especially in women at high risk for STDs	offer no protection	offer no protection	offer no protection	theoretically offer small protective effect, but no evidence available	offer protection by preventing pregnancy
Intrauterine device	offers no protection	offers no protection	progestin IUD may reduce risk	offers no protection	offers no protection	offers protection by preventing pregnancy
Oral contraceptives	offer no protection; conflicting evidence of influence on risk*	offer protection; effect increases with duration of use and remains for years after discontinuation	offer protection; effect increases with duration of use and remains for years after discontinuation	no difference in risk among pill users when breast cancer diagnosed at all ages before 55 is considered†	high estrogen-dose formulations increase risk; effect of low-dose pills unknown	offer protection by preventing pregnancy
Long-acting hormonal methods	offer no protection; conflicting evidence of influence on risk*	offer protection; effect increases with duration of use and remains for years after discontinuation	offer protection; effect increases with duration of use and remains for years after discontinuation	current evidence confused, because too few women available for study; no estrogen in methods, so effects might differ from those of oral contraceptives	probably do not change risk	offer protection by preventing pregnancy
Tubal sterilization	offers no protection	may reduce risk	offers no protection	offers no protection	offers no protection	offers protection by preventing pregnancy
Vasectomy	may reduce risk	offers no protection	offers no protection	offers no protection	offers no protection	offers protection by preventing pregnancy
Factors influencing risk	risk increases with either partner's number of sexual contacts; smoking increases risk	may be related to number of times a woman ovulates; rare in women who never ovulate; lactation may reduce risk	related to weight; rare in slim women	affected by age at first birth and number of children; lactation may protect against occurrence prior to age 50	alcohol abuse and hepatitis B infection increase risk	occurs as a result of pregnancy

*Users of hormonal methods seem to be at no greater risk than nonusers, based on studies controlling for frequency of cancer screening, smoking, number of sexual partners and use of barrier and spermicide methods.

†Pill use does not change risk in women who first used oral contraceptives after age 25—even after prolonged use; possibly increases risk of occurrence up to age 35 or 45 in women who have used oral contraceptives for prolonged period; possibly decreases risk for same women as they grow older.

known. One explanation may be that at the time of the operation, a surgeon can examine the ovaries and remove those with abnormalities that could put the woman at risk for ovarian cancer.[156]

Women who have used Depo-Provera have a decreased risk of ovarian and endometrial cancer.[157] The size of the decrease in ever-users of Depo-Provera is similar to that in ever-users of combined oral contraceptives. NORPLANT is expected to have th same effect, as are other progestin-only methods (long-acting hormonals or minipills). The progestin-only IUD is expected to offer some protection against endometrial cancer but is not likely to affect ovarian cancer. Research has not shown Depo-Provera to have a great effect on the risk of breast cancer. However, as is the case for oral contraceptives, results from different studies have been somewhat contradictory and confusing.[158]

Lastly, scientists are also questioning whether contraceptives used by men would affect their risk of cancers. Condoms should help protect men against cancers from viral infections (e.g., hepatitis B and HIV), but little research has measured this directly. Two recent studies have suggested that men who have had a vasectomy may have an increased risk of prostate cancer;[159] however, research that takes into account social and health differences between men who do or do not choose vasectomy will be needed to clarify this point.

Figure 10.7 provides a summary of the current knowledge about the effects of different methods of birth control on cancer.

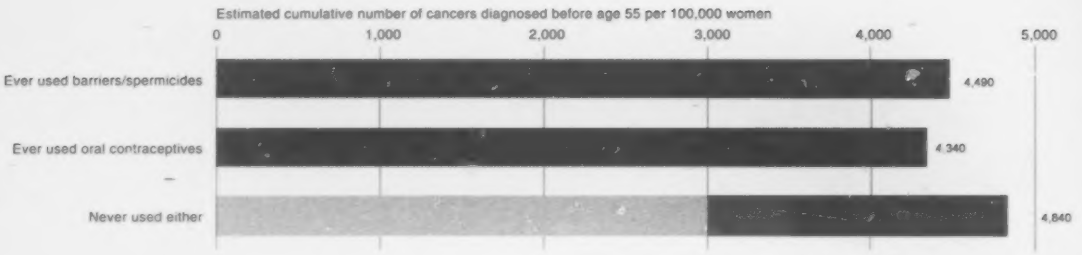
Putting Cancer into Perspective

Although cancers are not rare in women, and cancers of the reproductive system account for over half of those diagnosed during the childbearing years and from ages 45 to 54, the net effects of contraceptive use are small. Figure 10.8 shows estimates of all reproductive cancers in women who have ever used the pill or barrier or spermicide methods compared with women who have never used either. The figure shows the rate of diagnosis of the five cancers described in this chapter, as well as mortality from them, among all women up to the age of 55. By age 55, the rate of diagnosis per 100,000 women will be 500 less for pill ever-users than for never-users; it will be 350 less for ever-users of barrier or spermicide methods than for never-users.

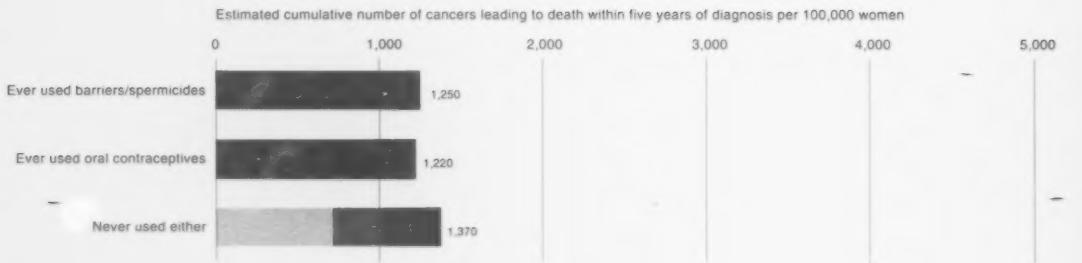
Numerical measurements of the incidence of one type of cancer may not be strictly equivalent to those for another because survival rates differ for the various types of cancer.[160] The five-year survival rate after a diagnosis of liver cancer is six percent; for

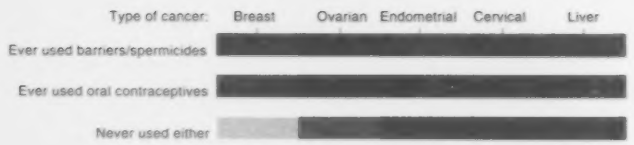
FIGURE 10.8

Women who have ever used the pill or barrier or spermicide methods will have fewer cancers of the reproductive system diagnosed by age 55 than those who have never used those methods, but the differences will be small.



Moreover, women who have ever used the pill, barrier or spermicide methods will also be slightly less likely to have cancers that will be fatal within five years of diagnosis.





ovarian cancer, 38 percent; for cervical cancer, 67 percent; for breast cancer, 76 percent; and for endometrial cancer, 85 percent.[161]

Figure 10.8 shows estimates of how ever-use of barrier or spermicide methods and oral contraceptives will influence the rate of diagnosis of these five cancers among women younger than 55. Compared with never-users of the respective methods, women who ever used the pill will experience 150 fewer deaths from cancer per 100,000 women, and ever-users of barrier or spermicide methods, 120 fewer deaths per 100,000. These differences are, perhaps, trivial when viewed against the cumulative incidence of all cancers (those of reproductive organs and those of other organs) between ages 15 and 55. On average, 7,730 cancers are diagnosed per 100,000 U.S. women over this 40-year age span.[162]

CHAPTER ELEVEN

Cardiovascular Disease

SUMMARY

Smoking is a major cause of heart and circulatory diseases. Birth control pills add to a woman's risk of some types of cardiovascular disease, but not to other types. The overall added risk for users of oral contraceptives is very low in young women and nonsmokers who are healthy and who have no predisposing factors for cardiovascular disease.

More than 20 years ago, researchers found that women taking oral contraceptives had an increased risk of cardiovascular disease.[163] However, since the discovery of this association, pill use appears to have become safer:[164] The doses of estrogen and progestin have been markedly reduced, and available evidence suggests that compared with the earlier formulations, current preparations are associated with a lower risk of cardiovascular disease among users relative to that among earlier users.[165] In addition, the diseases in question are becoming less prevalent, among both women and men;[166] as a result, the absolute risk of developing them has fallen, for both pill users and nonusers. Further, studies of cardiovascular diseases in women are revealing that, as is the case with men, they occur mainly among smokers and individuals with predisposing factors, such as diabetes, high blood pressure, high cholesterol, genetic abnormalities, a sedentary life-style or certain serious illnesses.[167] Consequently, it is now possible to identify many women who are at high risk for cardiovascular disease prior to their using the pill; those at high risk can choose another method, while others can be reassured that the likelihood of their developing a cardiovascular illness is extremely small.

Pill use affects only certain cardiovascular diseases: heart attack (myocardial infarction), two kinds of stroke—subarachnoid hemorrhage (bleeding from blood vessels surrounding the brain) and nonhemorrhagic strokes, due to thrombosis and embolism (blood clots in blood vessels to the brain)—and venous thrombosis and embolism (blood clots in veins, usually but not always in the legs). These conditions also occur in women who have never taken the pill. Several other types of cardiovascular disease do not appear to be related to oral contraceptive use.[168]

The incidence of cardiovascular disease rises with age; part of the increase is because conditions predisposing to cardiovascular disease (e.g., high blood pressure, diabetes and a sedentary life-style) are more frequent among older women.[169] Figures 11.1–11.3 show estimates of the effects of using the pill on the risk of different cardiovascular diseases for smokers and nonsmokers at different

ages. The diseases are discussed individually because the impact of pill use on the chance of developing them varies and because they differ in their likelihood of leading to death. The estimates for heart attacks have been adjusted in an attempt to exclude women with other known risk factors for cardiovascular disease, because oral contraceptives are usually contraindicated for such women.[170]

Cardiovascular Diseases Affected by Pill Use

Myocardial Infarction

Myocardial infarction (heart attack) is extremely rare in healthy women under 30 who do not smoke. Among such women, oral contraceptive users will experience less than one additional annual episode per 100,000 than will nonusers (Figure 11.1).[171] At ages 40–44, when the risk of myocardial infarction is higher, 100,000 nonsmoking pill users will have an estimated 10 more episodes of myocardial infarction and about two more deaths from it each year than will nonusers. Many of the heart attacks and resulting deaths can probably be avoided if the health of older oral contraceptive users is carefully monitored so that those who develop risk factors for myocardial infarction can change to another method of birth control.

Smoking, especially heavy smoking, raises the probability of myocardial infarction, increasing the risk as women age.[172] Among women who do not use the pill, those who smoke heavily (25 or more cigarettes per day) will experience more heart attacks beginning at age 20 than will nonsmokers. Oral contraceptive use compounds the risk of myocardial infarction among heavy smokers: Women who smoke heavily and use the pill will, even at ages 15–19, experience more myocardial infarctions than nonsmokers using the pill, or than heavy smokers not using the pill. By ages 40–44, heavy smokers will experience an estimated 421 more myocardial infarctions (and 106 more deaths) per 100,000 women annually if they use oral contraceptives than if they do not. They will have 450 more cases of myocardial infarction (and 113 more deaths) per 100,000 women than nonsmoking pill users aged 40–44.

Subarachnoid Hemorrhage

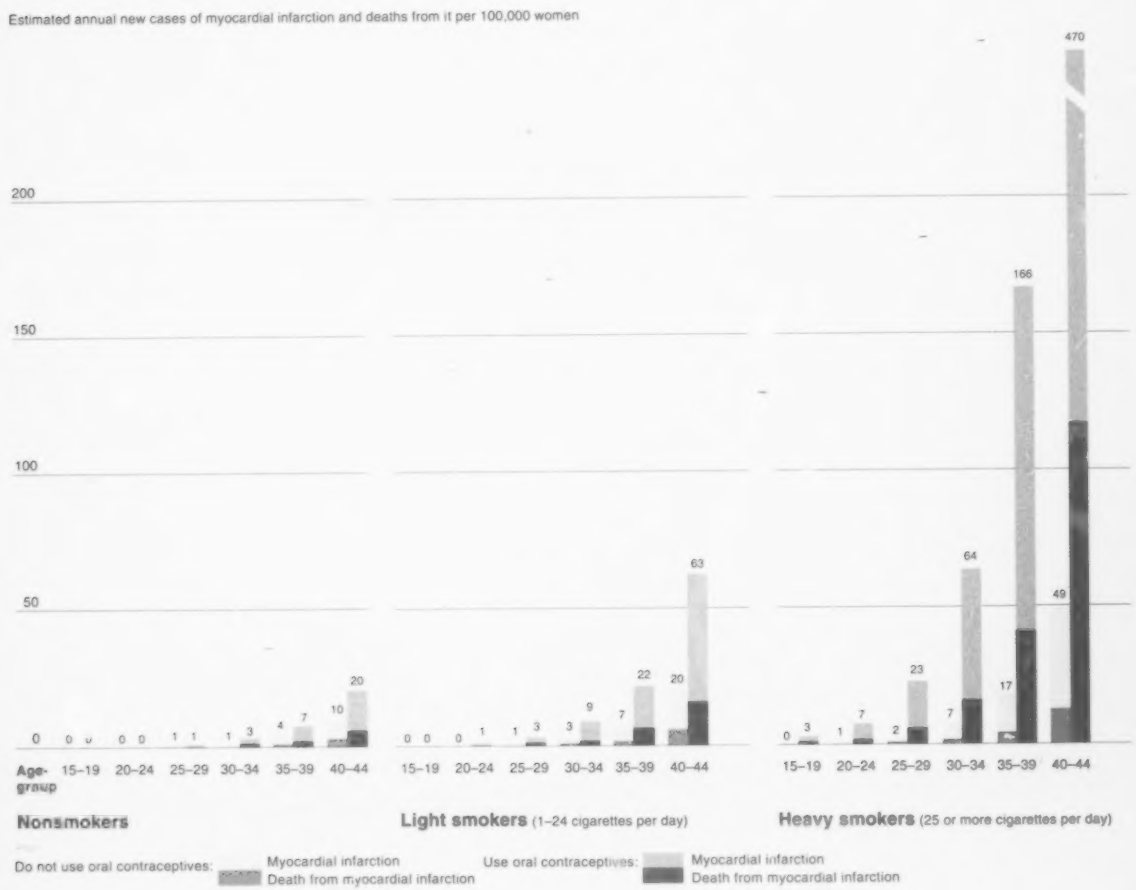
Bleeding from the blood vessels surrounding the brain is the main cause of the rare cases of stroke that occur among women of childbearing age. Smoking, high blood pressure and certain congenital abnormalities in the blood vessels increase the risk.[173] Among women under 35, strokes due to subarachnoid hemorrhage occur somewhat more than three times as often as myocardial infarctions, but at ages 40–44, they are less common.

FIGURE 11.1

The risk of myocardial infarction varies with age, pill use and smoking. For all women the risk increases with age. Among nonsmokers oral contraceptives add very little to that risk.

The risk of myocardial infarction is higher among light smokers than among nonsmokers, especially among older women, and oral contraceptive use further increases the risk.

Heavy smoking increases the effects of both age and oral contraceptive use on the risk of myocardial infarction.


Estimated annual new cases of myocardial infarction and deaths from it per 100,000 women
200
150
100
50
0 0 0 0 0 1 1 1 3 4 7 10 20
0 0 0 1 1 3 3 9 7 22 20 63
0 3 1 7 2 23 7 64 17 166 49 470
Age-group 15–19 20–24 25–29 30–34 35–39 40–44
Nonsmokers
Light smokers (1–24 cigarettes per day)
Heavy smokers (25 or more cigarettes per day)
Do not use oral contraceptives:
Myocardial infarction
Death from myocardial infarction
Use oral contraceptives:
Myocardial infarction
Death from myocardial infarction

Using oral contraceptives adds to the risk of this type of stroke, especially for women who smoke (Figure 11.2). However, the added risk from pill use among young women is extremely small. By ages 40–44, nonsmokers who take the pill will experience seven more strokes (and about two more deaths) per 100,000 each year than those who use other methods. Monitoring the health of pill users (e.g., checking blood pressure annually) can help decrease this risk; most cases of subarachnoid hemorrhage cannot be predicted, however.

Smoking adds to the risk of subarachnoid hemorrhage, even among women who do not use oral contraceptives. Pill use among smokers raises the risk even more, but as is the case with myocardial infarction, the absolute risk is small in young women. For heavy smokers aged 30–34, the difference is 103 strokes (with 26 more deaths) per 100,000 each year. The combination of heavy smoking and pill use leads to even higher rates of subarachnoid hemorrhage and resulting death at older ages.

Nonhemorrhagic Stroke

Oral contraceptive use also affects strokes not due to hemorrhage, but these events are much less common than either myocardial infarction or subarachnoid hemorrhage and much less likely to be lethal. Compared with nonsmoking women using other methods, nonsmoking oral contraceptive users will have about 0.5 more annual episodes per 100,000 before age 30, one more per 100,000 at ages 30–39 and three more per 100,000 at ages 40–44, with a negligible number of deaths (not shown). Smoking adds to the risk of these strokes.[174]

Venous Thrombosis and Embolism

Formation of a clot in the veins (venous thrombosis) is a relatively common occurrence in women of childbearing age; in contrast to myocardial infarction or subarachnoid hemorrhage, however, these clots (usually in the leg or pelvis) leave most affected women with no lasting consequences and are associated with low mortality. The likelihood of experiencing venous thrombosis is raised in women with hereditary predispositions to clotting, during infections, after injuries or operations, and in sedentary women. Occasionally, the clot becomes detached from the wall of the vein and moves to another point in the body, such as the lung, where it can cause an embolism (blockage of a major vessel).

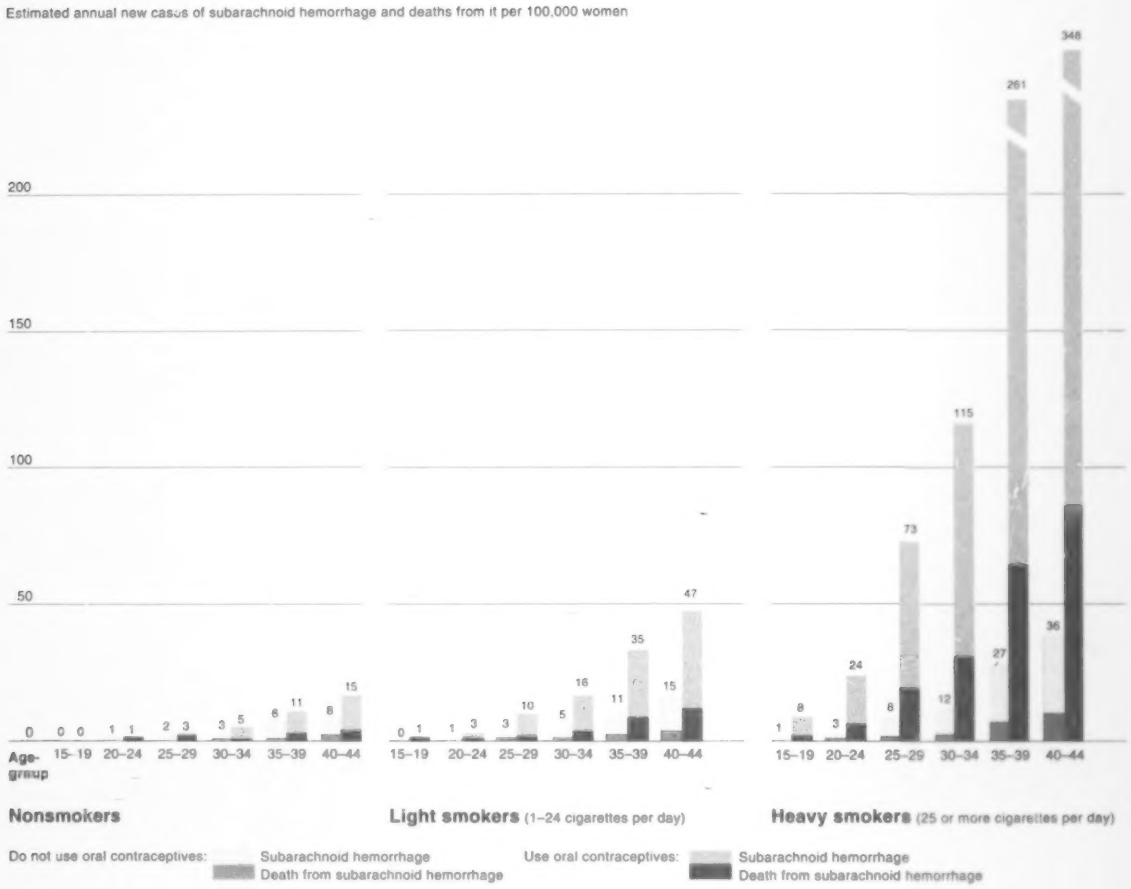
Oral contraceptives increase the risk of venous thrombosis and embolism. Age, however, has less influence than it has on the

FIGURE 11.2

Oral contraceptive use adds little to the risk of stroke due to subarachnoid hemorrhage and death from it among nonsmokers.

But light smokers greatly increase their risk if they use oral contraceptives.

And heavy smokers who use oral contraceptives, especially at older ages, have even greater risks.


Estimated annual new cases of subarachnoid hemorrhage and deaths from it per 100,000 women
200
150
100
50
0 0 0 1 1 2 3 3 5 6 11 8 15
0 1 1 3 3 10 5 16 11 35 15 47
1 8 3 24 8 73 12 115 27 261 36 348
Age-group
15–19 20–24 25–29 30–34 35–39 40–44
Nonsmokers
Light smokers (1–24 cigarettes per day)
Heavy smokers (25 or more cigarettes per day)
Do not use oral contraceptives:
Subarachnoid hemorrhage
Death from subarachnoid hemorrhage
Use oral contraceptives:
Subarachnoid hemorrhage
Death from subarachnoid hemorrhage

other cardiovascular diseases affected by the pill. Although smoking influences the risk of venous thrombosis and embolism,[175] it does not interact with oral contraceptive use as it does for myocardial infarction and subarachnoid hemorrhage.[176]

As Figure 11.3 shows, compared with nonsmokers using other methods, those using oral contraceptives will experience from two more disease episodes per 100,000 each year at ages 15–19 to 32 more per 100,000 users aged 40–44. Heavy smoking among women not using oral contraceptives will add even more disease episodes, up to 97 per 100,000 aged 40–44. The combination of smoking, increasing age and pill use will raise the risk, but less than it does for myocardial infarction and subarachnoid hemorrhage. It will add about one death per 100,000 annually at ages 40–44.

Additional Considerations

Discontinuing Pill Use

The effects of the pill on the incidence of cardiovascular illness disappear rapidly if a woman discontinues use. Within about one month, a pill user's increased risk of having a myocardial infarction or venous thrombosis returns to normal, as do laboratory measures of the blood's tendency to form clots.[177] Former pill users seem to be left with no residual effects no matter how long they had used the pill.[178]

Smokers can also reduce their risk of cardiovascular disease if they stop smoking. For example, about three years after quitting, their risk of a heart attack returns to that of nonsmokers.[179]

Effects of Different Oral Contraceptives

The doses of hormones in the various pills seem to influence the likelihood of a user's developing cardiovascular disease,[180] and the estrogen and progestin have differing effects. Estrogen influences blood clotting in complex ways; it is believed to be the hormone that contributes more strongly to the increased risk of heart attack and venous thrombosis and embolism among oral contraceptive users. Since contraceptives containing lower doses of estrogen have become more widely used, evidence has emerged suggesting that cardiovascular disease among pill users has become less common.[181] Now, with even fewer women using high-dose pills,[182] the risk of myocardial infarction in women using this method may have dropped even more—but proof of this is still lacking.

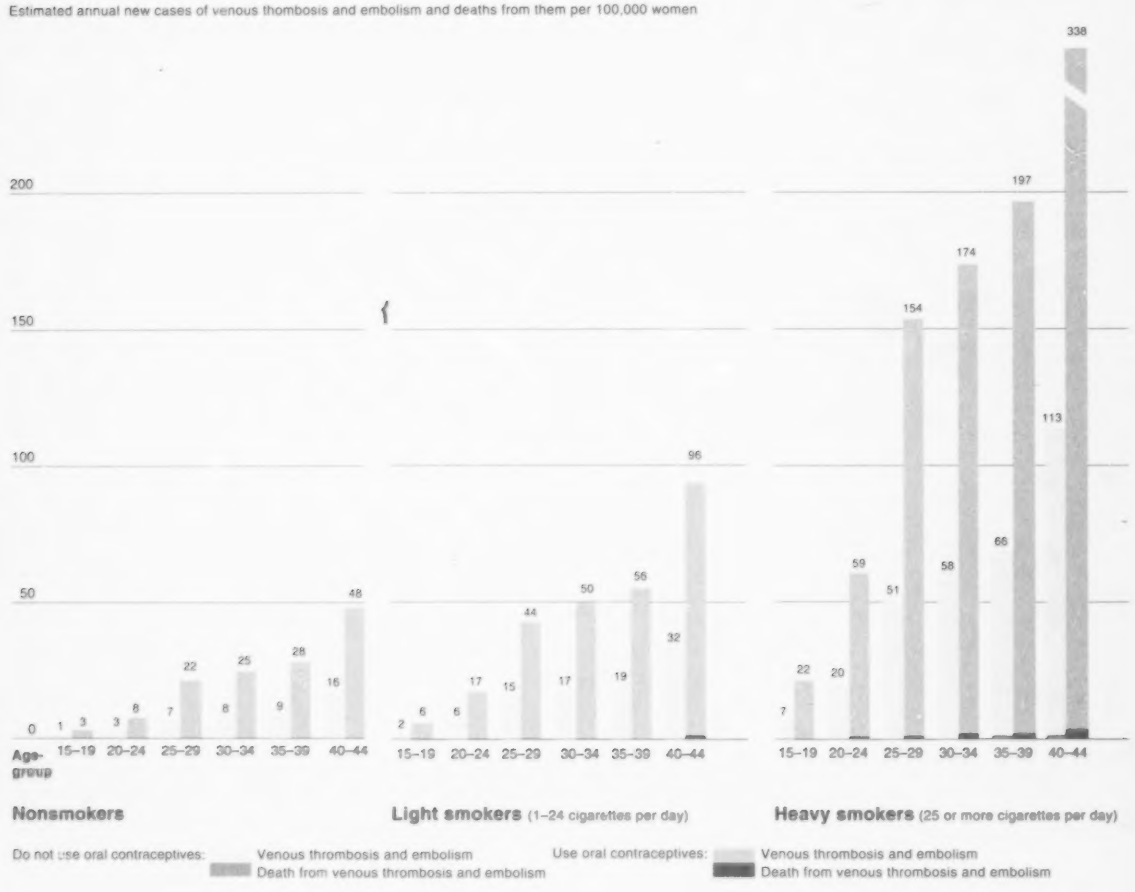
Progestins cause small and subtle changes in blood pressure,[183] blood sugar and insulin, as well as somewhat larger changes in cholesterol and related lipids.[184] Because these are important in

FIGURE 11.3

Venous thrombosis and embolism are more common than the other cardiovascular diseases, and oral contraceptive use adds to their risk.

Smoking combined with oral contraceptive use increases the risk of venous thrombosis and embolism.

Older women who are heavy smokers and use oral contraceptives have especially high risks of this disease; even among them, however, mortality from venous thrombosis and embolism is rare.



predicting the incidence of cardiovascular disease,[185] some scientists believe that the amount of progestin in the pills—and the type of progestin—will affect the relationship between oral contraceptive use and cardiovascular disease. As a result, pills containing lower doses of progestins and new progestins have been developed; they are designed to affect the various blood lipids and other factors even less than earlier pills did. Data are not yet available, however, to determine whether changing the progestin actually affects the risk of heart disease. Meanwhile, most of the changes in blood pressure, cholesterol and blood sugar that oral contraceptives cause are not large; in an individual woman, they may be much smaller than the beneficial changes that she herself can bring about—by maintaining a healthy diet, doing aerobic exercise regularly and avoiding obesity.

Long-Acting Hormonal Contraceptives

Minipills, injectables and implants contain no estrogen, and their daily doses of progestin are considerably lower than those found in combined oral contraceptives. For this reason, progestin-only methods of birth control may be safer than ordinary oral contraceptives. However, data indicating whether this is so are not yet available.

Cardiovascular Disease in Pregnancy

During pregnancy, and particularly during childbirth, a woman is at greatly increased risk for some cardiovascular diseases, including stroke, venous thrombosis and embolism and certain other rare types of heart disease.[186] In the United States, approximately 40 percent of maternal deaths, or about 3.2 per 100,000 live births, are attributable to cardiovascular disease.[187] In addition, during pregnancy some women experience special types of diabetes and high blood pressure, which may predispose them to heart disease and stroke in the future.[188] Thus, the small increase in risk for certain cardiovascular diseases among women currently using oral contraceptives needs to be balanced against an increased risk of the same, and other, cardiovascular conditions that can result from pregnancy and childbirth if a woman chooses a less-effective method of birth control or uses no method.[189]

Comparing Health Effects of Contraceptive Methods and Contraceptive Failure

CHAPTER TWELVE

Complications Requiring Hospitalization

SUMMARY

In addition to preventing pregnancy, birth control methods can influence health through their side effects, either beneficial or harmful. These side effects may occur because of direct effects of the method or indirectly, as a result of pregnancies due to contraceptive failure. When side effects requiring hospitalization are considered, IUDs, oral contraceptives and vasectomy offer health benefits that most strongly outweigh the risks associated with their use.

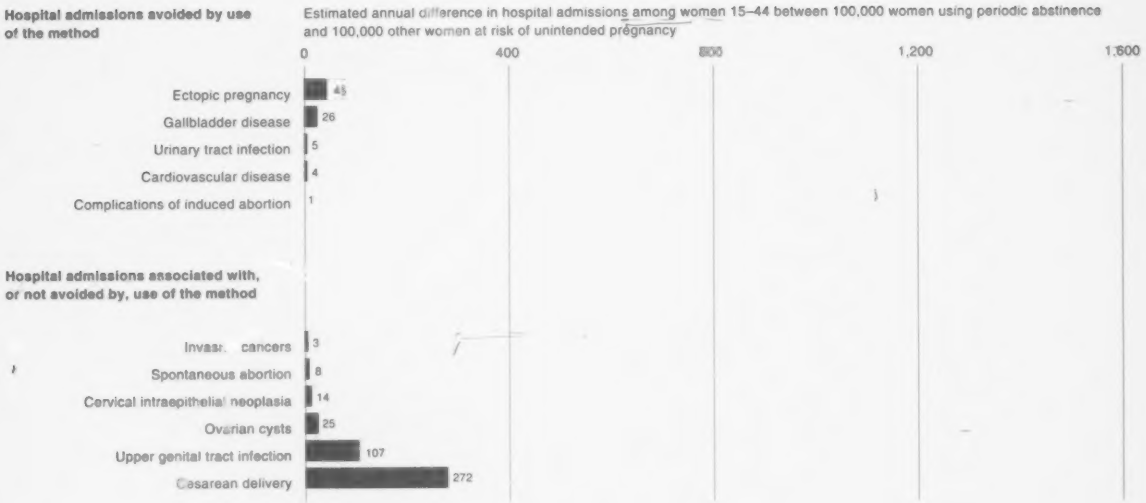
Some methods may benefit a woman's health other than by preventing pregnancy, while other methods may be harmful for particular users. Some of the health consequences associated with using contraceptives, as well as with not doing so, are severe—as described in previous chapters—and some are bothersome, but not life threatening. Certain methods carry a one-time risk, such as infection or bleeding, at the time their use is begun (i.e., the surgical risk associated with sterilization and insertion of the IUD or implants). Other effects may be apparent while the method is being used or many years later. In this chapter, we bring together common health conditions that are affected by contraceptive use and focus on those conditions that are serious enough to warrant admission to a hospital.

In the figures, we compare the estimated number of hospital admissions among a group of women currently using a particular method with that among all other women at risk of unintended pregnancy (i.e., those who are aged 15–44, sexually active and currently wishing to avoid pregnancy and are using other contraceptives or no method, distributed as shown in Figure 4.1); in some cases, the total number of women experiencing a specific condition is also discussed in the text.[190] In these calculations, we have assumed that half of those pregnancies that are not ectopic and do not result in spontaneous abortion would end in birth and half in induced abortion, as is the case in the United States.[191]

Some of the strongest health effects of practicing contraception derive from how well the method prevents pregnancy, because pregnancy itself poses a variety of health risks for the woman, some quite severe. About one percent of pregnancies are ectopic (i.e., they implant in the fallopian tubes or somewhere else outside of the uterus—see chapter 8); all women who have an ectopic pregnancy will require hospital care.[192] Trophoblastic disease occurs in roughly 0.1 percent of pregnancies (see chapter 10). Approximately 15 percent of pregnancies end in spontaneous abortion, some of which require hospitalization[193] (see appendix A). If the pregnancy contin-

FIGURE 12.1

The principal health risks associated with periodic abstinence are related to its lack of protection against upper genital tract infection and to its high failure rate, which leads to more cesarean deliveries.



ues, nearly one woman in seven will experience a complication.[194] For instance, about eight percent of women develop pregnancy-associated hypertension,[195] and many develop a urinary tract infection. Some women develop complications that require hospital care. During labor and delivery, about one-third of women have complications (excluding problems of the fetus or newborn); major difficulties include obstructed labor, severe lacerations of the cervix or vagina and postpartum hemorrhage.[196] Approximately one-quarter of births are delivered by cesarean section.[197] Only two-fifths of women giving birth can expect to have a normal pregnancy and delivery.[198]

The majority of the most serious complications of pregnancy occur during the third trimester and at the time of delivery. Induced abortion averts all of these, but planning to use no method of birth control and to terminate the resulting pregnancies with induced abortions is not without health risks. Such a strategy would lead to a large number of pregnancies, because women undergoing abortions can become pregnant again within a short period. For instance, 100,000 women aged 15–44 adopting this approach would have 95,000–180,000 pregnancies and 66,000–164,000 induced abortions each year (depending on their age).[199] Compared with an equal number of women using no method and planning to give birth, they would have more ectopic pregnancies, more sponta-

neous abortions and more cases of trophoblastic disease. They could expect about 70–130 admissions to the hospital each year (depending on age) as a result of complications of induced abortion (70 complications per 100,000 induced abortions).[200]

The health conditions discussed in this chapter include both those that may be directly affected by method use and those that are associated with pregnancies that occur as a result of contraceptive failure. Because of limitations in available data, not all conditions are shown for each method.

Periodic Abstinence

No health complications are directly attributable to periodic abstinence; consequently, a common assumption is that this is a "healthier" method for women to use than other contraceptives. However, while periodic abstinence does not share the risks of many other methods, it also shares few of their benefits. The difference between the major health effects of using periodic abstinence and those of the other methods or no method is shown in Figure 12.1.

A group of 100,000 women aged 15–44 using periodic abstinence will experience at least 13,800 accidental pregnancies each year, and 2,080 spontaneous abortions;[201] an equal number of other women at risk of unintended pregnancy would, on average, have fewer unintended pregnancies. As a result of these unintended pregnancies, 100,000 users of periodic abstinence will have an estimated 272 more cesarean deliveries than 100,000 other women at risk of unintended pregnancy, assuming that both groups choose to deliver or terminate their pregnancies in equal proportions.[202]

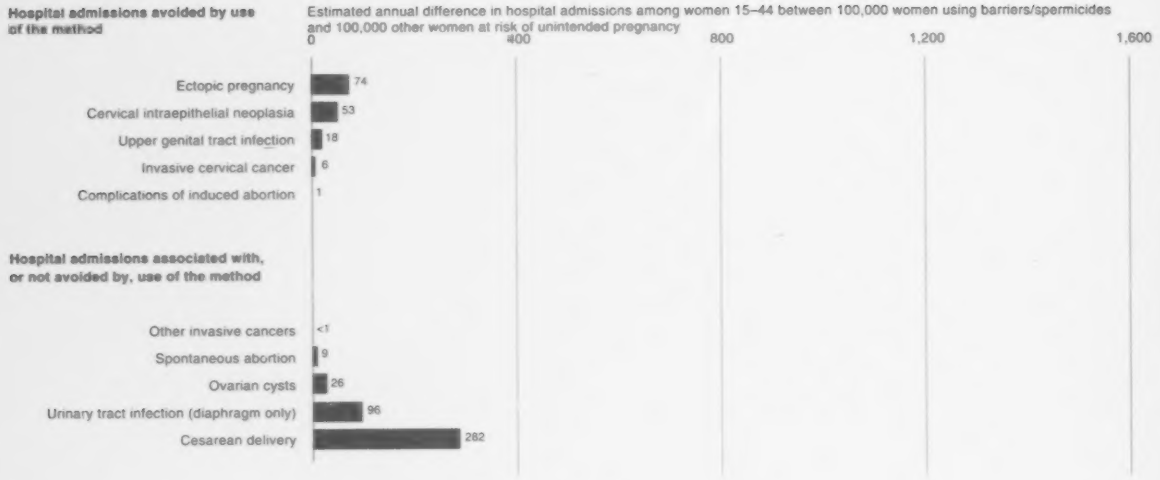
Periodic abstinence has a less-positive influence on health than other methods have. Not only does its use result in more health complications from pregnancy, but it provides no protection against upper genital tract infection, tubal infertility, cervical cancer, cervical intraepithelial neoplasia (a form of cervical cancer that is not yet invasive) and ovarian cysts (see chapters 7, 9 and 10). However, women using periodic abstinence will have fewer ectopic pregnancies than other women at risk of unintended pregnancy. Women relying on periodic abstinence will also have slightly fewer episodes of certain conditions that tend to occur in other women at risk of unintended pregnancy (e.g., gallbladder disease, cardiovascular disease and urinary tract infection). This is not because periodic abstinence actually prevents these conditions; rather, the risks are increased among users of some other methods that are used by large proportions of other women at risk of unintended pregnancy. But these benefits are small—at least in numerical value—when compared with the excess risk of hospital admissions that users of periodic abstinence will face.

Withdrawal

Like periodic abstinence, withdrawal carries no risk directly attributable to it; in fact, the two methods are associated with similar health effects. Theoretically, withdrawal should help prevent upper genital tract infection and cervical cancer and its precursors, but there is no available evidence to confirm these hypotheses.[203]

FIGURE 12.2

Risks of hospitalization are small for women using barrier and spermicide methods.



Barrier and Spermicide Methods

No health risks are directly attributable to condom use, for either the man or the woman. Spermicides (which are often used with the condom and diaphragm) occasionally cause minor sensitivity reactions in either partner, but virtually none of these reactions are serious enough to lead to hospital admission. The only known health risk associated with using a diaphragm is that of urinary tract infection.[204] Diaphragm users will, on average, experience an estimated 96 per 100,000 more annual admissions to the hospital for acute urinary tract infection than will women using other methods (Figure 12.2); they will also have even more treated on an outpatient basis. Barrier and spermicide methods are less effective than many other contraceptives in preventing pregnancy; thus, users will experience slightly more cesarean deliveries and complications of spontaneous abortion because they will have more pregnancies than other women at risk of unintended pregnancy. However, the differences are very small. In addition, these methods offer no protection against ovarian cysts.

Compared with women relying on other methods, users of the barrier and spermicide methods will have an estimated 53 fewer hospital admissions per 100,000 for cervical intraepithelial neoplasia.[205] They will also have fewer cases of this condition not leading to admission to the hospital, as well as of cervical dysplasia, a precan-

cerous lesion, and about six fewer hospital admissions per 100,000 each year for invasive cervical cancer. But perhaps the greatest benefit of barrier and spermicide methods is that they prevent a substantial number of hospital admissions for upper genital tract infection, ectopic pregnancy and tubal infertility (see chapters 7–9).

The various barrier and spermicide methods may differ in the health benefits they provide. Although in theory the condom should offer better protection than the diaphragm against sexually transmitted diseases (STDs), studies have consistently shown diaphragm users to have a lower incidence of STDs than women whose partners are using condoms,[206] as well as a lower incidence of pelvic inflammatory disease (PID).[207] Whether women are more consistent in the use of diaphragms than men are in using condoms, whether the spermicide (with which a diaphragm is typically used) is responsible for the added protection,[208] or whether, in real life, couples using the two types of method cannot be compared because they differ—in sexual behavior or other characteristics—is not known. Few data are available on the cap, the sponge and spermicides used alone, but they are generally assumed to have effects similar to those of the condom and the diaphragm.

IUD

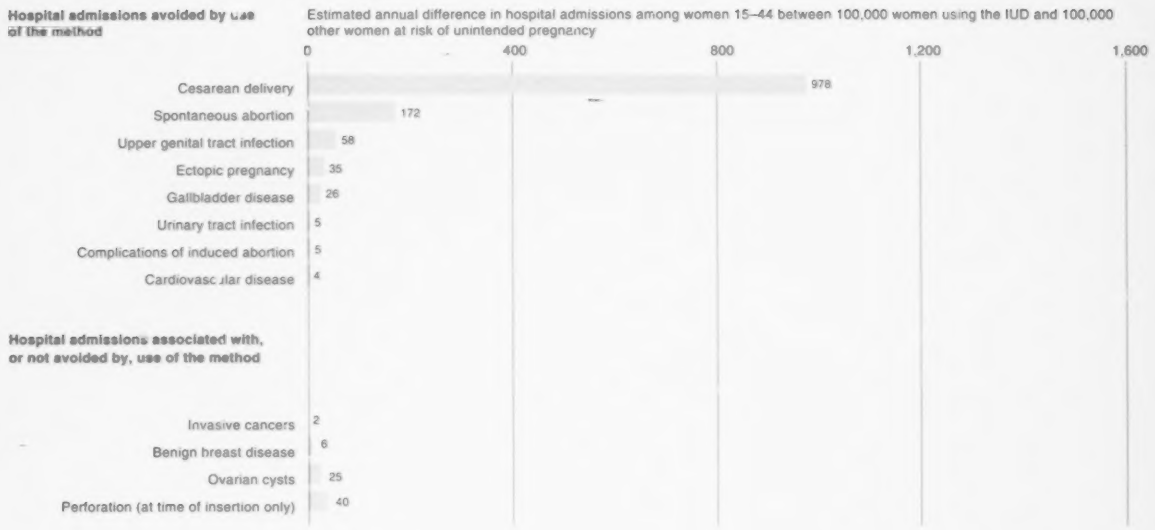
The benefits of the copper-bearing IUD derive from its effectiveness as a contraceptive (Figure 12.3). Women using the copper IUD will experience many fewer pregnancies than a comparable number of those using other methods. They will, therefore, have fewer cesarean deliveries and fewer hospitalizations for spontaneous or induced abortion. Each year, the method will prevent about 35 hospitalizations for ectopic pregnancy per 100,000 women. The progestin IUD will prevent slightly fewer admissions for ectopic pregnancy, because the probability of such an event is higher with this device.[209] The progestin-containing IUD may carry some side benefits from the presence of the hormone, because the progestin reduces bleeding,[210] and should theoretically lead to lower rates of infections.[211]

Since the IUD is contraindicated for women not in mutually monogamous relationships, we have assumed that all IUD users are at low risk for STD in Figure 12.3. If the copper IUD is used by women in mutually monogamous relationships, they would have about 58 fewer hospital admissions for upper genital tract infection than all other women at risk of unintended pregnancy because some of these other women will be in relationships that are not mutually monogamous (Figure 12.3). However, if mutually monogamous IUD users were compared only with women who are also mutually monogamous, users of a copper IUD would have an estimated 43 more hospital admissions per 100,000 because of upper genital tract infection than other women at risk of unintended pregnancy.[212] For a more in-depth exploration of these complications, see chapters 7–9.

Other potential complications of the copper IUD are infection, iron-deficiency anemia resulting from increased menstrual flow and perforation at the time of insertion; perforation may lead to about 40 hospital admissions per 100,000 insertions.[213] However, because the device can remain in place for up to six years, the inser-

FIGURE 12.3

Each insertion of a copper-bearing IUD carries a low risk of perforation, but since the method can remain in place for up to six years, this risk is small compared with the benefits associated with its use.



tion-related risk will not recur annually. The progestin IUD needs to be replaced annually, so reinsertion introduces a potential risk of perforation and infection each year.

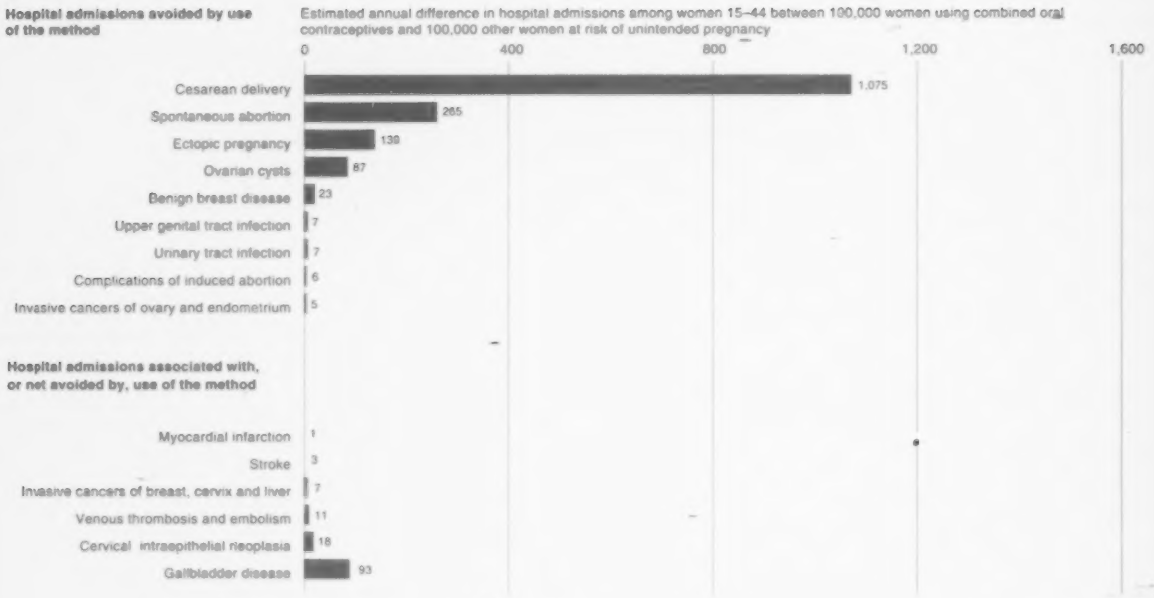
Combined Oral Contraceptives

An estimated 1,614 per 100,000 current pill users avoid being hospitalized each year because of protective effects of the pill (Figure 12.4). Balanced against this, an estimated 133 per 100,000 require hospitalization as a result of conditions that occur more commonly in pill users than in other women at risk of unintended pregnancy. In addition, the pill prevents and adds many less-serious conditions that do not usually lead to hospital admission and for which no reliable statistics exist.

Oral contraceptive use decreases the incidence of benign breast disease (the longer the use, the lower the incidence): Compared with users of other methods, pill users experience 200–250 fewer new cases per 100,000 annually and 23 fewer hospital admissions per 100,000.[214] Pill use also prevents hospital admissions for ovarian cysts, which usually necessitate surgery,[215] for upper genital tract infection (see chapter 7) and, possibly, for fibroids (not

FIGURE 12.4

Use of combined oral contraceptives prevents many more hospital admissions than it adds.



shown).[216] Pill users also have fewer pregnancy-related hospital admissions because of the pill's relatively low failure rate.

For women aged 15–44, the beneficial effects of birth control pills on ovarian and endometrial cancers are almost balanced by the extra cases of breast and liver cancers that may occur in users: The net effect of pill use will be about two more hospital admissions for cancer per 100,000 users than among a group of 100,000 other women at risk of unintended pregnancy.

Women using the pill are less likely than others to experience iron-deficiency anemia and severe menstrual pain.[217] Since during menstruation about 10 percent of women experience pain sufficient to necessitate their stopping work or household activity,[218] the pill could be preventing approximately 89,000 lost workdays per year for each 100,000 users.[219]

On the negative side, pill users have an estimated 93 more annual hospital admissions for gallbladder disease per 100,000 than other women at risk of unintended pregnancy; approximately 345 admissions will be added during the first year of pill use, but virtually none thereafter.[220] Compared with other women at risk of unintended pregnancy, oral contraceptive users will experience 15 more

hospitalizations for cardiovascular disease—myocardial infarction, stroke and episodes of venous thrombosis and embolism—per 100,000 users (see chapter 11). Other common (and often transient) side effects of pill use, not requiring hospitalization, are nausea, breast soreness or enlargement, weight gain or loss, dizziness and chloasma. In addition, some women using oral contraceptives may develop hypertension (blood pressure of 140/90 or higher).[221]

Progestin-Only Methods

Fewer than one percent of women using oral contraceptives are taking progestin-only minipills.[222] Several million women around the world, but few women in the United States, use injectable contraceptives—Depo-Provera and NET.[223] Many fewer women worldwide rely on implants (NORPLANT); they have been used for a shorter period of time and have only recently become available in the United States. The injectable and implant methods are considerably more effective in preventing pregnancy than any other reversible method of birth control. The contraceptive effects of these methods, as well as impacts of their current use on health, last until the injection wears off or the implant is removed.

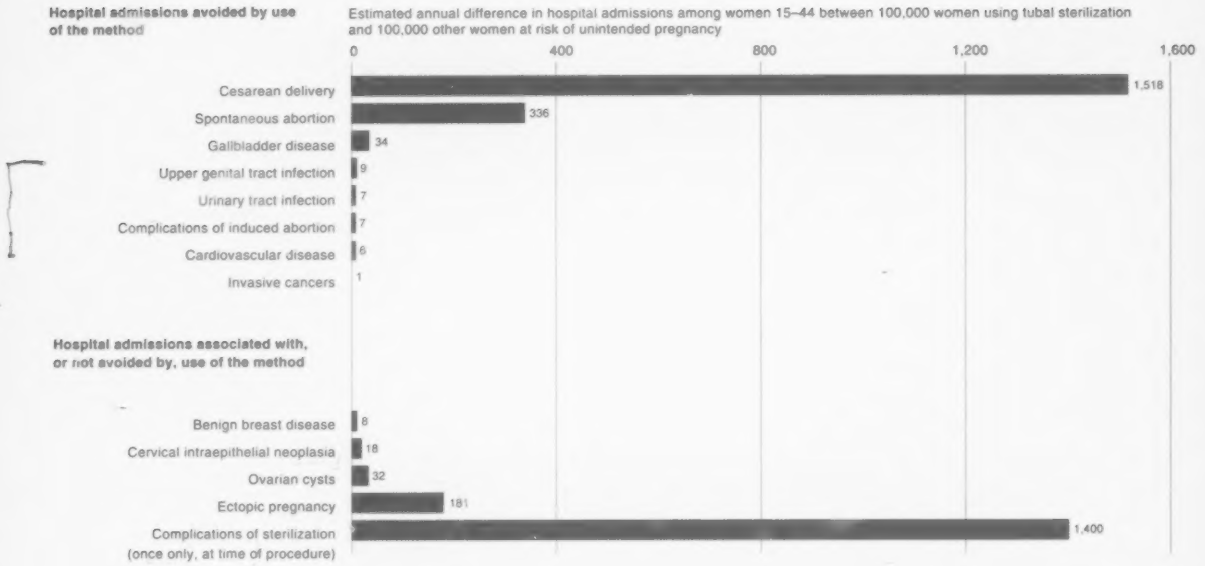
All of the benefits and risks of these progestin-only methods are not yet fully known and understood. It is expected, however, that these progestin-only methods share with combined oral contraceptives those health effects that are attributable to progestins.

Progestin-only methods are expected to have effects on PID, benign breast disease and ovarian cysts that are similar to those of combined oral contraceptives, because these benefits are related to effects of progestin. Since the risks of myocardial infarction and venous thrombosis and embolism are believed to be affected primarily by the estrogen in combined pills, women using progestin-only formulations will probably experience lower levels of these conditions than users of combined oral contraceptives. However, there is some evidence of an increase in blood pressure associated with progestin use.[224] Because an increase in blood pressure is a risk factor for stroke, there may be an increase in the risk of stroke for users of progestin-only methods; any added risk is probably extremely small. Progestin-only formulations are preferable to estrogen-containing formulations while women are breastfeeding, because, in contrast to estrogen-containing methods, they do not reduce the quantity of milk, change its quality or curtail the duration of breastfeeding.[225]

A drawback of progestin-only methods, for some women, is that they cause changes in bleeding patterns. Bleeding may be irregular and, as time goes on, many users develop amenorrhea, especially those using injectables and implants. Amenorrhea itself is not a health risk; some women object to it, however, and may decide to discontinue use of the method because of it. However, some 10–100 per 100,000 women using NORPLANT will experience bleeding severe enough to require that they stop using the method.[226] Other side effects of progestin-only methods are headaches, depression, dizziness and weight gain; as with combined oral contraceptives, these effects are often transitory.

FIGURE 12.5

Complications from tubal sterilization occur only once, at the time of the operation; benefits remain for the rest of a woman's reproductive life.

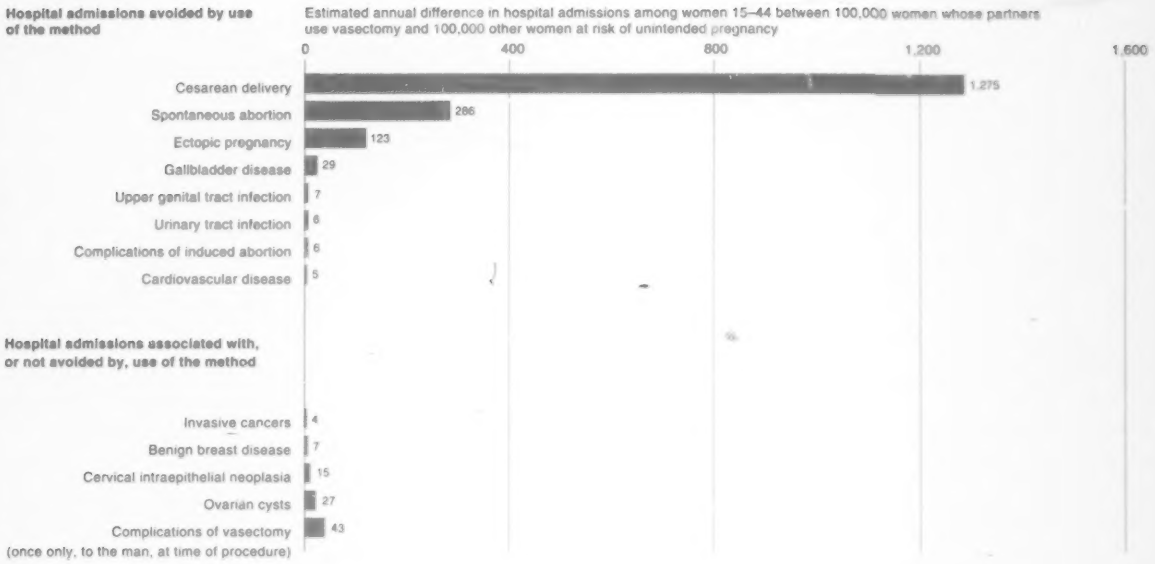


Studies show that, like combined pills, Depo-Provera helps protect against ovarian and endometrial cancer.[227] While data on progestin-only pills and implants are not available, it is believed that NORPLANT probably will provide the same protection, particularly because the hormone it contains—levonorgestrel—is one that has been used in combined oral contraceptives for many years. Similarly, progestin-only pills contain progestins that have been used in combined oral contraceptives. Depo-Provera has not been shown to be associated with any large change in the risk of breast cancer;[228] however, as is the case with the possible relationship between combined oral contraceptives and breast cancer, scientists cannot yet tell whether prolonged use has small effects, especially among younger women.

Like the combined pill, progestin-only methods do not protect against cervical cancer. Whether women using these methods will have a different risk of this disease than women using other nonbarrier, nonspermicidal methods who have an equal number of sexual partners is unknown.

FIGURE 12.6

Vasectomy is associated with even fewer complications than is tubal sterilization.



Sterilization

The main health benefits from both vasectomy and tubal sterilization stem from their effectiveness in preventing pregnancy (Figures 12.5 and 12.6). Most of the risks from these methods occur only once, at the time of the surgery.

For a couple who have decided to rely on sterilization, the health risk to the man is considerably lower if he has a vasectomy than the woman's risk if she is sterilized. Depending on the sterilization technique used, between 800 and 2,000 women per 100,000 can expect a major complication (infection, bleeding or complications of anesthesia) at the time of the operation, compared with 43 per 100,000 men having vasectomies.[229]

Regardless of the procedure used, sterilization has a small chance of failure. If a woman becomes pregnant after a tubal sterilization, the probability is high that the pregnancy will be ectopic.[230] Thus, compared with all other women at risk of unintended pregnancy, those relying on tubal sterilization will experience 181 per 100,000 more hospital admissions per year for ectopic pregnancy (Figure 12.5) and those relying on vasectomy, about 123 fewer (Figure 12.6).

CHAPTER THIRTEEN

Mortality

SUMMARY

Deaths associated with contraceptive use are relatively rare in the United States. Rates vary according to both the likelihood of pregnancy while the method is being used and any risks attendant to the method itself. The probability of death resulting from use of a contraceptive needs to be balanced against the probability of death from pregnancy and childbirth if no method is used—at all ages, contraceptive use prevents deaths, compared with using no method. In addition, oral contraceptives and barrier and spermicide methods avert future deaths by their protection against cancer.

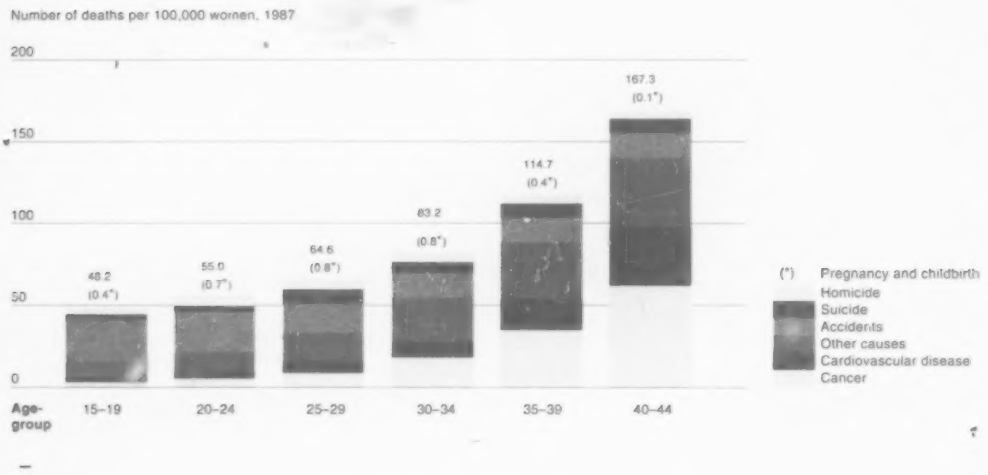
About 50,000 American women aged 15–44 die each year.[231] While accidents, homicide and suicide are the most common causes of death among young women, cancer and cardiovascular disease contribute a greater share of deaths as women get older (Figure 13.1). Pregnancy and childbirth, once major causes of mortality among women, now rarely lead to death. In 1987 (the latest year for which statistics are available), 251 of the reported deaths of women were related to pregnancy and childbirth, accounting for less than one percent of deaths among women aged 15–44.[232]

A woman's contraceptive choice can affect her risk of death in a number of ways. First, as long as she is sexually active and not infertile, she faces a risk of pregnancy and, therefore, a risk of dying from a complication of pregnancy, childbirth or abortion. Thus, death rates among contraceptive users will vary according to each method's failure rate; whether a contraceptive failure is likely to lead to a complication, such as ectopic pregnancy; and whether women choose to terminate their pregnancies by abortion or give birth. Second, some contraceptives add to the probability of death while they are being used and affect a woman's risk of developing, and dying from, cancer in the future. Third, a method may change a woman's risk of becoming infected with HIV or other sexually transmitted viruses, affecting her future risk of developing, and dying from, cervical cancer or AIDS.

Comparing the mortality rates among women using different methods of birth control can be a useful way of examining the methods' health effects. Deaths represent the tip of the iceberg; a much larger proportion of women suffer illnesses or disabilities. More precise information is available on mortality than on the incidence of many of the complications described in the previous chapters, however, so death rates may be more accurate as a proxy for major illnesses than are the rates currently available for those illnesses.

FIGURE 13.1

Deaths associated with pregnancy and childbirth constitute only a small fraction of deaths among all U.S. women of reproductive age.



Pregnancy-Related Deaths Prevented by Current Use

Most pregnancy-related deaths occur among women having complications of late pregnancy and during delivery, and among those needing interventions (e.g., cesarean delivery). Although pregnancy-related deaths are rare, pregnancy and childbirth are inherently dangerous times in a woman's life, made safer by good medical care and by the availability of induced abortion for women at high risk of dying during pregnancy or childbirth.

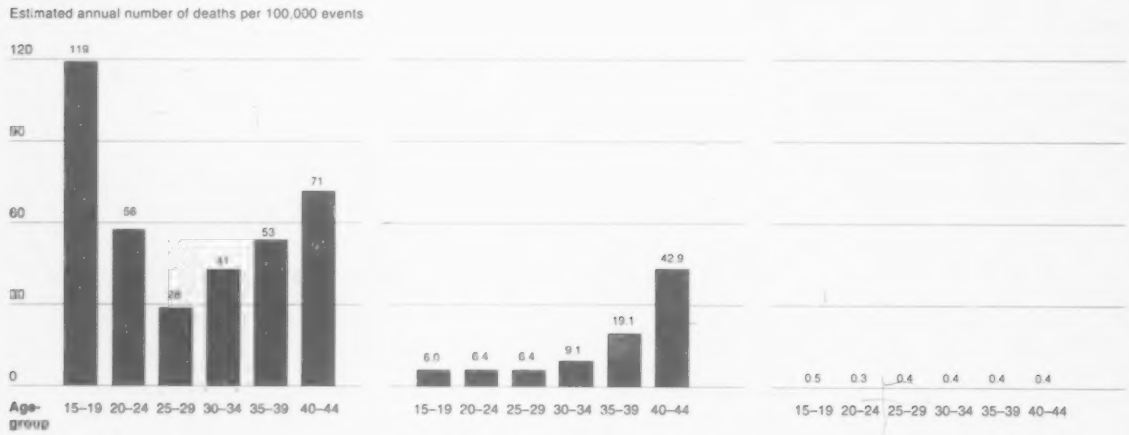
The risk of a death associated with pregnancy depends on the woman's age and on the outcome of the pregnancy (Figure 13.2). Ectopic pregnancy carries the highest risk of death (49 per 100,000 ectopic pregnancies); pregnant women in the youngest and oldest age-groups are at highest risk of dying from it. Childbirth carries the next-highest risk of mortality (eight per 100,000 births),

FIGURE 13.2

No matter what their outcome, pregnancies involve a risk of dying. At all ages, women having an ectopic pregnancy are by far at the greatest risk of pregnancy-related death.

Pregnancies ending in birth involve higher risks at older ages.

Pregnancies ending in induced abortion involve a low risk regardless of age.

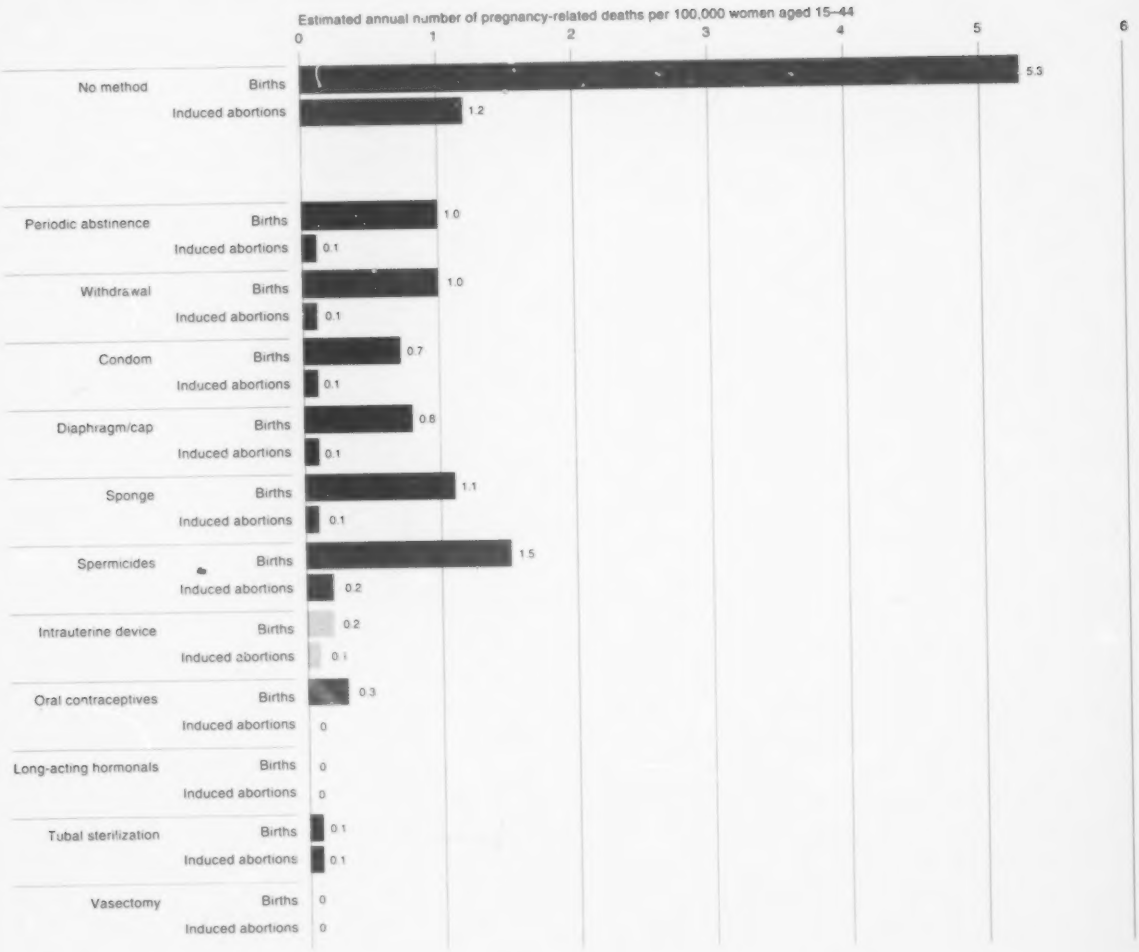


and the risk increases with age. Mortality associated with induced abortion is less than one-tenth that related to childbirth (0.4 per 100,000 induced abortions). The risk of dying from spontaneous abortion is believed to be slightly higher than that for induced abortion, but reliable statistics on it do not exist.[233]

Figure 13.3 presents the estimated numbers of pregnancy-related deaths per 100,000 women using the different contraceptive methods, for both women who choose to give birth and for those who choose abortion. These estimates are based on the low range of contraceptive failure rates. Among groups of women with higher failure rates, the pregnancy-related mortality rates would be higher, both for those choosing birth and for those choosing abortion. The highest mortality rate in both groups of women is among those using no contraceptive. Among such women, as well as among those

FIGURE 13.3

Pregnant women choosing to give birth face a higher risk of death than those choosing abortion. Women who use a contraceptive reduce their risk of death by decreasing their risk of pregnancy. Pregnancy-related deaths are least common among women using the most effective methods.



who become pregnant while using methods with high failure rates, abortion can prevent about three-quarters of pregnancy-associated deaths. This is because most deaths occur in late pregnancy and at childbirth. By contrast, among women relying on the IUD or tubal sterilization, pregnancy-related deaths are more often due to ectopic pregnancies than to other complications, and few can be averted by induced abortion.

In Figure 13.4 we show how age affects the probability of pregnancy-related death following contraceptive failure or nonuse. Estimates shown in this figure are based on the assumption that all pregnancies from contraceptive failures that do not result in ectopic pregnancies or spontaneous abortions result in births. Although failure rates for many methods decrease with age, the risks of pregnancy-related death shown in the figure generally rise with age, especially after age 30. Complications of pregnancy become more common with increasing age, and the rates of associated fatality rise. As a result, older women using methods with high failure rates tend to have higher death rates from pregnancy-related causes than younger women using the same methods.

Increased Risk from Current Use of Some Contraceptives

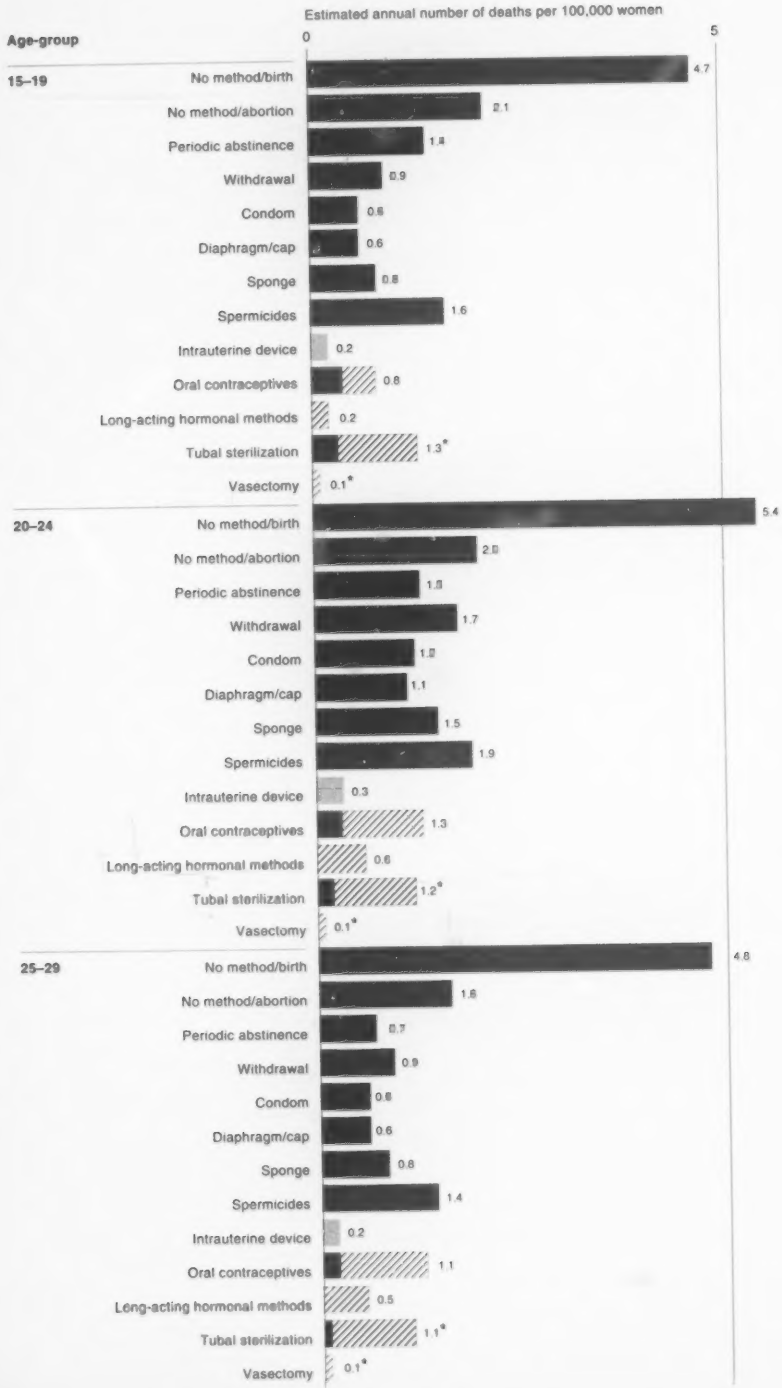
As is also shown in Figure 13.4, use of some contraceptives carries a risk of death that is not related to the risks of pregnancy if the method fails, but rather is due to the method itself or to the interaction between effects of the method and other health and behavioral characteristics of the user. Among women in mutually monogamous relationships, the IUD will add an estimated 0.01 deaths per 100,000 (about one in 10 million) because of users' additional risk of developing pelvic inflammatory disease.[234] Vasectomy carries with it a one-time risk of death for the man at the time of the operation, but this risk is extremely small; the very rough estimate used here is 0.1 per 100,000 vasectomies—about one in a million.[235] The one-time risk of death from tubal sterilization is higher than that associated with vasectomy, but is also very low—roughly estimated here as one per 100,000 operations.[236]

While they are being used, oral contraceptives add to the very small likelihood of death from cardiovascular disease. As shown in chapter 11, most of the risk is found among smokers, especially those who smoke 25 or more cigarettes per day. But if smokers who are at an increased risk for cardiovascular disease (i.e., those who are 25 or older and smoke heavily and all smokers who are 35 or older) chose not to use oral contraceptives, or alternatively, if oral contraceptive users chose to cut back on or quit smoking, the estimated risk of death that would be attributable to pill use would range from 0.4 to 1.6 per 100,000 women depending on their age (Figure 13.4). This risk is very small compared with the annual mortality rate from all causes of death, 48.2–167.3 per 100,000, among U.S. women at those same ages (see Figure 13.1).

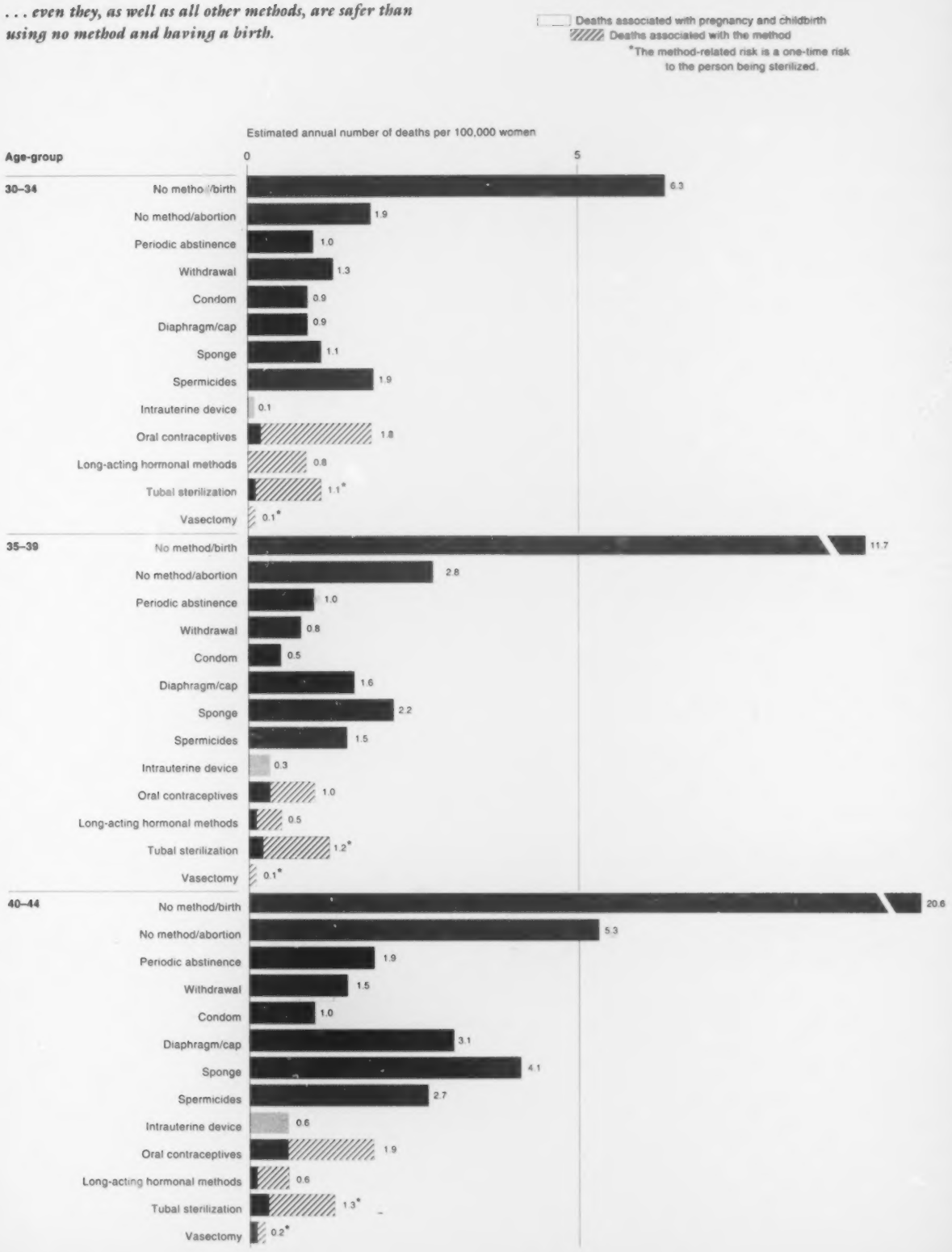
Because the methods that carry some direct risk are the most effective in preventing pregnancy, most of the mortality associated with their use comes directly from the method rather than indirectly through contraceptive failure. Still, the IUD (used by

FIGURE 13.4

Contraceptives avert deaths by preventing pregnancy and childbirth, which become riskier with age. Although hormonal methods and sterilization involve risks of death from method-related causes . . .



. . . even they, as well as all other methods, are safer than using no method and having a birth.



women in mutually monogamous relationships) and vasectomy offer the lowest total mortality risk at all ages. Oral contraceptives are associated with lower risks than many of the behavioral or barrier and spermicide methods for women aged 15–24.

Current and Future Deaths Averted by Use of Certain Methods

Contraceptives can also prevent deaths many years in the future, by helping to prevent cancers and sexually transmitted viral infections. As shown in chapter 10, oral contraceptives will avert some future deaths from ovarian and endometrial cancers, and barrier and spermicide methods will avert some from cervical cancer. In addition, condoms will prevent some HIV infections and may avert conditions that can result from sexually acquired hepatitis B infection, such as cirrhosis of the liver; other barrier and spermicide methods may do so too.[237]

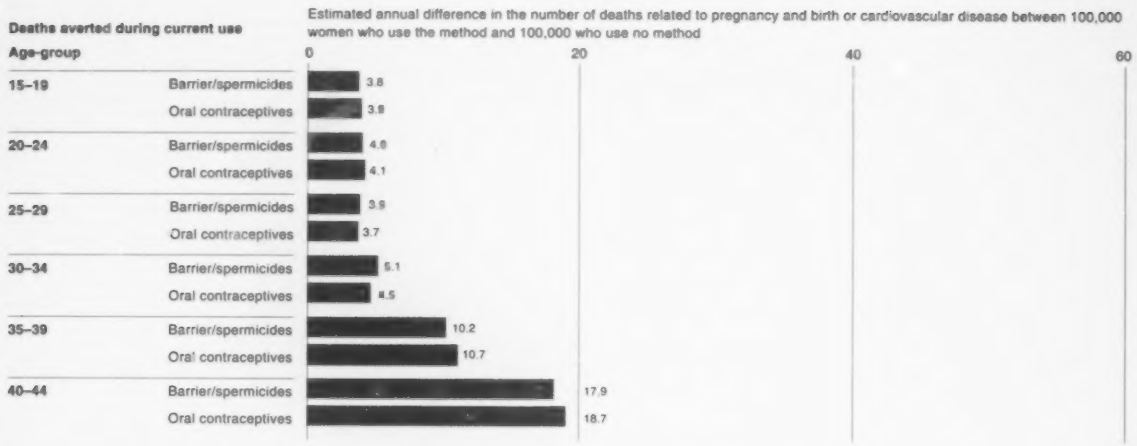
Figure 13.5 shows the annual number of deaths prevented during current use of barrier and spermicide methods and oral contraceptives, compared with women using no method. It also shows the number of future cancer deaths prevented before age 45 as a result of ever having used these methods, compared with that among women who have never used them. For example, among 100,000 women aged 15–19 using barrier and spermicide methods there will be an estimated 0.9 annual deaths associated with pregnancy and childbirth following contraceptive failure (see Figure 13.4)—3.8 fewer than if they used no method and chose to give birth. They will also have reduced their risk of dying from cervical cancer compared with what it would be if they had never used a barrier or spermicide method: Using such methods at ages 15–19 will prevent an estimated 60 future deaths before age 45 from cervical cancer per 100,000 women. This long-term protection will continue even if the user changes methods after age 20. Oral contraceptive users aged 30–34 will experience an estimated 1.8 annual deaths per 100,000, resulting primarily from cardiovascular disease and in part from pregnancy and childbirth following contraceptive failures. But this will be 4.5 fewer than if they had used no method, and an estimated 15 future deaths per 100,000 women will be prevented—prior to the age of 45—by the pill's contribution in helping to prevent ovarian and endometrial cancers.

Use of oral contraceptives or barrier or spermicide methods will avert many more deaths among women 45–54 (not shown). Use of barrier or spermicide methods during the reproductive years will prevent an estimated 45 deaths per 100,000 women between the ages of 45 and 54, while use of oral contraceptives will prevent an estimated 99 deaths per 100,000.

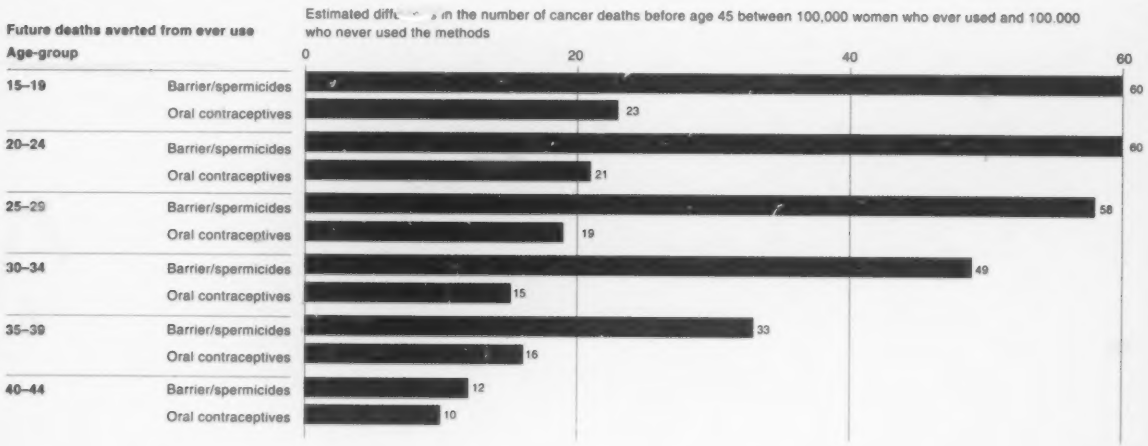
Other methods of birth control can also help prevent some cases of cancer, but because their effects are not well quantified, we have not included them in Figure 13.5. Withdrawal and vasectomy may reduce the risk of cervical cancer, and tubal sterilization may help prevent ovarian cancer. Long-acting hormonal methods will help protect against both endometrial and ovarian cancer. Thus, although deaths of women can, and do, occur while they are using birth control, most methods can influence a woman's health favorably, in a way likely to reduce mortality in middle age.

FIGURE 13.5

Contraceptive use saves lives. Women using barrier or spermicide methods or oral contraceptives have fewer deaths while using these methods than if they used no method.



Contraceptive use also prevents death from another perspective: Women who have ever used barrier or spermicide methods or oral contraceptives will experience fewer deaths from cancer before age 45 than if they had never used these methods.



CHAPTER FOURTEEN

Preventing Pregnancy, Protecting Health

SUMMARY

Contraceptives differ in their implications for preventing pregnancy, preserving fertility and protecting health. In addition, individuals' behaviors can influence a contraceptive method's effects. Women and men should be aware of the implications of their behaviors and tailor their contraceptive choice to meet their own concerns and goals. But the paramount message is clear: Couples who use any method are far more likely than those who use no method to prevent pregnancy, preserve fertility and protect health.

Couples choosing contraceptive methods have differing goals. Many have not yet begun childbearing and wish to delay doing so until they feel better able to raise a family. Others have already had a child, but want to extend the time until their next pregnancy; still others have had all the children they want and wish to prevent any more pregnancies. Some couples may not wish to have any children. In addition to being concerned about how effective a method will be at helping them prevent pregnancy and what effect it will have on their future fertility, women and men may worry about the implications of method use on health, especially the woman's. *Preventing Pregnancy, Protecting Health: A New Look at Birth Control Choices in the United States* shows that while no one birth control method is ideal for all couples at all times of their reproductive lives, some methods are more likely than others to enable couples to reach their family planning goals, and to reach them in good health.

The likelihood of achieving these goals is affected not only by the choice of a contraceptive method, but also by the behavior of the woman and her partner. When choosing a method, individuals need to consider a variety of factors in addition to their childbearing aspirations: their sexual behavior, their individual and family health histories, health habits (such as smoking), and, perhaps most important, their willingness and ability to use a particular method consistently and correctly. We have examined implications of three types of behavior in particular that are strongly linked to whether couples will be able to achieve their reproductive and health goals, in many cases regardless of which contraceptive method they choose. Women and men who have multiple sexual relationships or are involved with partners who have had other relationships are at risk for sexually transmitted disease (STD). Women who contract an STD are, in turn, at an elevated risk for pelvic inflammatory disease (PID), which can lead to infertility. Couples who use a method inconsistently or incorrectly—or who use no method—are more likely than others to have an unintended pregnancy; pregnancy and child-

birth increase a woman's risk of illness and mortality. Finally, women who smoke put their health at risk; regardless of the method they use, such women are at increased risk for illness and mortality from cardiovascular disease.

Comparing Methods

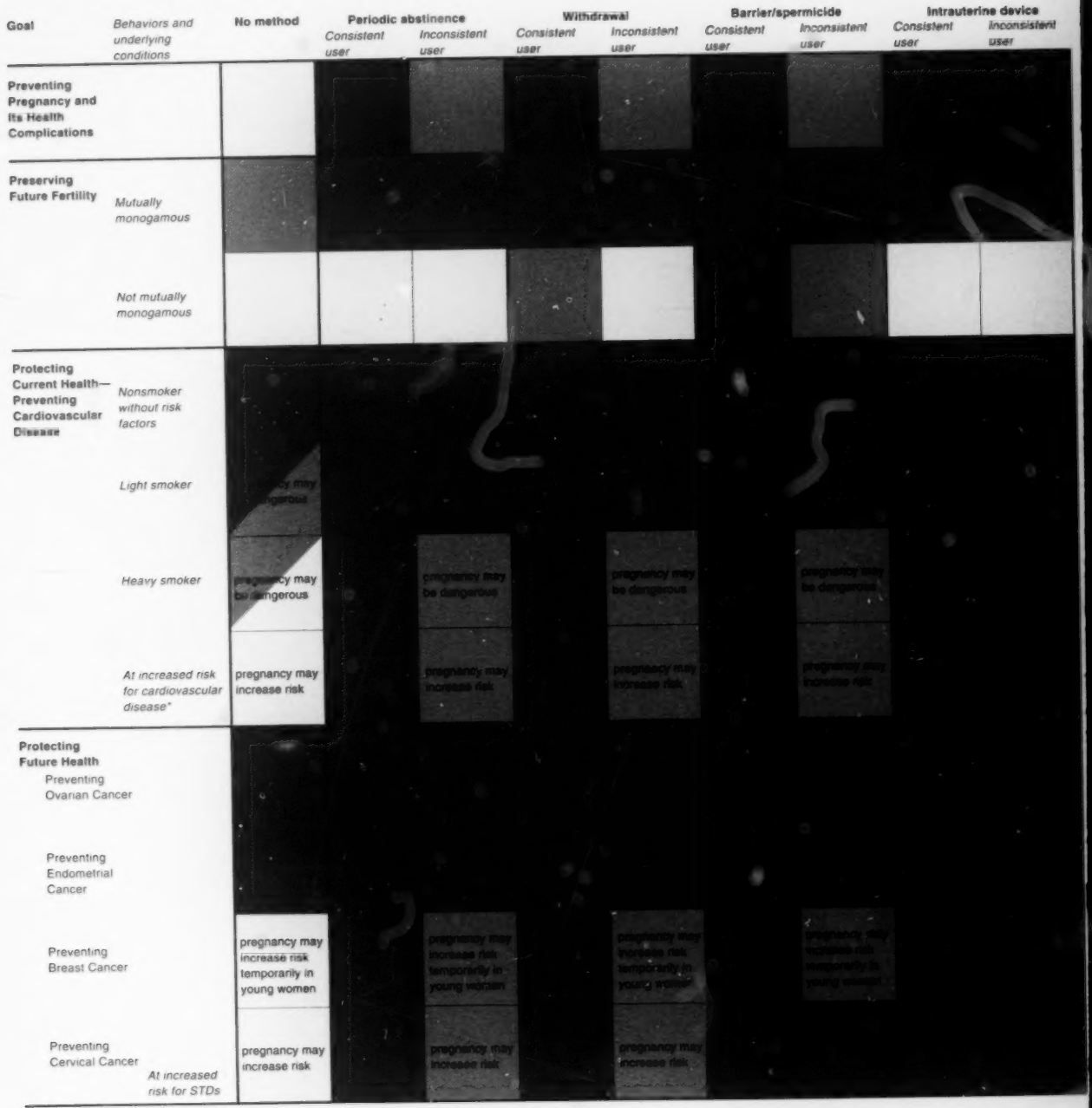
Figure 14.1 summarizes our current knowledge about the effects of the various contraceptive choices on the risk of unintended pregnancy and on future fertility and health, according to a woman's behavior and underlying health factors. We use five shades of blue to indicate how good a particular contraceptive choice is, relative to others, in the context of a woman's goals or concerns (i.e., preventing pregnancy, preserving future fertility and protecting current and future health) and her behavior or other characteristics (i.e., sexual relationships, smoking and underlying health conditions). In addition, we distinguish between consistent (regular and correct use of the method) and inconsistent use (irregular or incorrect use) of each contraceptive because inconsistent use greatly diminishes the potential benefits of many methods and increases the risk of encountering health problems.

The two darkest shades of blue indicate the methods that are most likely to help a woman reach a specific goal. The darkest blue signifies that a method will greatly improve a woman's chances of reaching the particular goal under the given conditions. The next shade lighter indicates that a method will also improve a woman's chances of attaining the goal, but less so than some other contraceptive options. The middle shade of blue (labelled in the key as a "satisfactory choice") denotes methods that do not affect a woman's chances of reaching the particular goal. The two lightest shades indicate choices that decrease a woman's chances of reaching her goal relative to other available options for women in the category.

Couples who use any contraceptive have a better chance of preventing pregnancy and pregnancy-related health complications than couples who use no method, especially if they use the method consistently and correctly. Methods that must be used around the time of intercourse—periodic abstinence, withdrawal and barrier and spermicide methods—are more susceptible to failure when they are not used correctly. Women who choose contraceptives that are not directly linked to the timing of intercourse—the IUD, the pill, long-acting hormonal methods and sterilization—generally have lower unintended pregnancy rates, and fewer pregnancy-related health effects, than others.

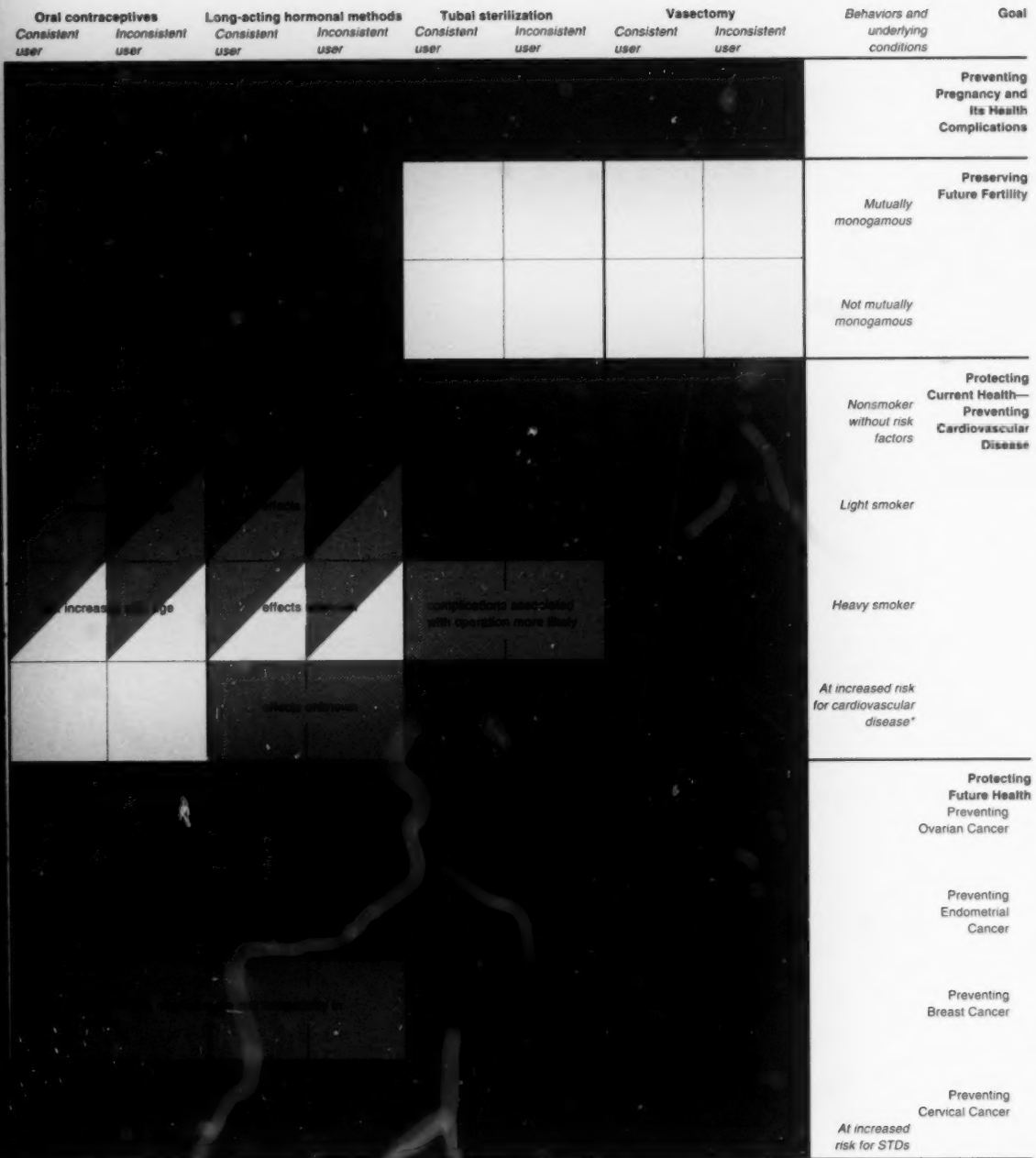
FIGURE 14.1

Contraceptives differ in their implications for preventing pregnancy, preserving fertility and protecting health; using any method will greatly improve a woman's chance of reaching her reproductive and health goals.



Consistent user: uses the method correctly and at every act of intercourse
Inconsistent user: uses method incorrectly or has unprotected intercourse; will face a higher risk of pregnancy than consistent users

*high blood pressure, high cholesterol, diabetes, previous thrombosis or embolism, family history of heart attack before age 60



The particular choice, compared with the other contraceptive options for women with the specified behaviors and underlying health conditions, is an . . .

- **excellent choice:** It greatly increases the chance of attaining the goal.
- **good choice:** It increases the chance of attaining the goal.
- **satisfactory choice:** It does not affect the chance of attaining the goal.
- **poor choice:** It decreases the chance of attaining the goal.
- **very poor choice:** It greatly decreases the chance of attaining the goal.

Monogamous couples concerned with preserving the woman's future fertility have many good contraceptive choices, especially if they use the method consistently and correctly. Those who are in relationships that are not monogamous have limited contraceptive options if being able to have children in the future is important to them. Barrier and spermicide methods offer the best protection against infertility; hormonal methods may also provide a high degree of protection even though they do not prevent STDs.

In addition to health risks related to unintended pregnancies, a major concern regarding the effect of method choice on current health is the likelihood of developing cardiovascular disease. Women who do not smoke and are not at increased risk for cardiovascular disease for any other reason (i.e., high blood pressure, high cholesterol, diabetes, previous thrombosis or embolism, and family history of heart attack before age 60) can choose any contraceptive method with the assurance that the risk to their health is extremely small. Among women who smoke, especially those who smoke heavily, or who are at risk for cardiovascular disease for other reasons, using hormonal contraceptive methods may raise the chance of developing cardiovascular disease. Women with risk factors for cardiovascular disease may also increase their chances of developing the disease if they use no method or use their method inconsistently, because pregnancy may increase the risk.

Some contraceptive choices can affect the probability that a woman will develop cancer. Women who use hormonal methods for long periods may also have an increased risk of breast cancer for a number of years, but not throughout their lives. However, hormonal methods strongly protect against ovarian and endometrial cancer at all ages. Barrier and spermicide methods clearly lower women's risk of cervical cancer by reducing the likelihood of sexually transmitted infection. When women of all ages are considered together, those who have used oral contraceptives have the same incidence of breast cancer as women who have never used the pill. There are uncertainties, however, about the effects of oral contraceptives on women's probabilities of being diagnosed with breast cancer at relatively young ages.

When they choose a contraceptive method, women not only must consider their own behaviors and health characteristics but also must weigh multiple goals simultaneously. For example, a woman in a relationship that is not mutually monogamous may view the IUD as very attractive for its high level of protection against pregnancy, but will find the method inappropriate because it is associated with an increased risk of PID among women exposed to

STDs. Barrier and spermicide methods would be a more appropriate choice, but their protection against pregnancy is not as great as that of the IUD (and is weakened, along with their protection against STDs, when use is inconsistent). The woman may consider using more than one method. For instance, she may choose to use oral contraceptives (because of their effectiveness in preventing pregnancy) in conjunction with a barrier or spermicide method (to protect against STDs).

Because needs, options and preferences change during the reproductive years, women and men should reevaluate their choice of birth control method from time to time. A change of sexual partner, a commitment to mutual monogamy, a pregnancy, a completed family—all these events mark points in a woman's life when she should reassess her contraceptive needs and choices.

Preventing Pregnancy, Protecting Health: A New Look at Birth Control Choices in the United States focuses on the benefits and risks of using contraceptive methods now available in the United States. In coming years, new and better methods may be introduced, giving couples more options. More experience with long-acting hormonal methods will accrue, a greater variety of barrier and spermicide methods may come onto the market and completely different types of drugs and drug delivery systems may make their appearance. Better understanding of reproductive cancers and more research on breast cancer may alter our view of the benefits and risks of oral contraceptive use for young women. In the meantime, *Preventing Pregnancy, Protecting Health* provides the most up-to-date information on the health effects of the methods currently available.

Many conclusions can be drawn from the vast amount of information presented in this book. However, the paramount message is that using a contraceptive—any contraceptive—consistently and correctly is a far more certain way of maintaining good health than using no method. Good health can also be promoted, and future fertility protected, by avoiding smoking and exposure to STDs. The sexually active woman who uses no method not only is at a greatly increased risk of an accidental pregnancy, but also has no opportunity to gain from the benefits of contraceptives.

Challenges for the Future

The information we have presented will be reassuring to many; nonetheless, the data presented here outline clear challenges for women and men who are concerned about their own reproductive

and health goals, as well as for those concerned from the perspective of public health and public policy.

The experience of centuries has shown that behavioral—and ultimately societal—change is difficult to achieve; such change cannot be the only approach. Nor can the special needs of those whose behavior lowers their chance of achieving their reproductive and health goals—a group to which most of us belong at some time or another—be ignored. An important step, however, would be more honest, forthright consideration of the extent to which one's behavior interacts with health and with the effects of contraceptive methods. Individuals need to be more frank with each other and with themselves about possible exposure to STDs. Physicians and other medical providers need to discuss sexual behavior and the mechanics of contraceptive use with patients rather than assume that they have no exposure to infection or that they know how and are able to use their chosen method correctly and consistently. A better sense of how current and future behavior might affect health and influence a contraceptive method's effects can help women and men make choices about their behavior and their contraceptive that will be better tailored to their own concerns and goals.

The reality of people's lives and of the methods available today present challenges that must be dealt with now. They also make clear the continuing need for the development of new methods of contraception—methods that would involve fewer trade-offs between goals (e.g., by offering very low pregnancy rates and a high degree of protection against STDs); methods that demand little user attention, but that do not require the cost or commitment of semipermanent or permanent methods; and methods that allow men to be more involved as contraceptive users.

Work is underway to meet many of these challenges: Individuals struggle to cut back on smoking and try to find ways to talk to their partners about what method to use or about their risk of infection. Scientists toil in laboratories to develop and test ideas for new methods. Policymakers seek to reduce the personal and societal burdens of unplanned pregnancy, infertility and ill health. All work to meet the challenges we face as we try to address today's behaviors and goals with methods that were developed yesterday.

1 Jones et al., 1989.
2 Jones et al., 1989.
3 Mastroianni et al., 1990; Potts, 1988.
4 Jones et al., 1989.
5 Forrest and Henshaw, 1983; Silverman et al., 1987.
6 Jones et al., 1986.
7 See Klitsch, 1989.
8 Forrest and Singh, 1990.
9 See note to Figure 2.6.
10 Forrest and Singh, 1990.
11 Forrest and Singh, 1990.
12 See note to Figure 2.6.
13 The Alan Guttmacher Institute, 1990a.
14 Trussell and Grummer-Strawn, 1990.
15 Trussell and Kost, 1987; Trussell et al., 1990.
16 Silverman et al., 1987; Kisker, 1985.
17 Hatcher et al., 1990.
18 Hatcher et al., 1990.
19 The overall incidence of toxic shock syndrome in the United States appears to be extremely small ("Reduced incidence of menstrual toxic-shock . . . ," 1990), and it is not clear that the risk increases among diaphragm, cap or sponge users (Hatcher et al., 1990). Nevertheless, package inserts for these methods alert users to danger signs of toxic shock syndrome and recommend that users take such precautions as washing their hands before insertion or removal and removing the device after no more than 24 hours following insertion.
20 No longer than 60 minutes prior to intercourse (Hatcher et al., 1990).
21 Sivin, 1989.
22 Bergqvist and Rybo, 1983; Larsson and Fianu, 1983; Andrade and Orchard, 1987; McCarthy et al., 1984; Ory et al., 1983.
23 Hatcher et al., 1990.
24 Hatcher et al., 1990.
25 Optimally, 12–24 hours after intercourse (Hatcher et al., 1990).
26 An IUD inserted within seven days of unprotected intercourse also may avert pregnancy, most likely by preventing implantation of a fertilized ovum (Hatcher et al., 1990).
27 Gold, 1983; "Public board of inquiry . . . ," 1985.
28 Hatcher et al., 1990.
29 Oakley and Parent, 1990.
30 See Gold, 1990.
31 Centers for Disease Control, 1989.
32 Aral and Holmes, 1990.
33 Brabin, 1985; Brunham et al., 1990.
34 Gutman and Wilfert, 1990; Harrison and Alexander, 1990; Schulz et al., 1990; Rubinstein, 1990; Hill, 1990; Stagno and Whitley, 1990; Kashima et al., 1990.
35 This is the case for those with HIV, herpes simplex, cytomegalovirus, human papillomavirus, molluscum contagiosum, hepatitis B virus and untreated syphilis.
36 Hepatitis B virus is associated with primary liver cancer; HIV is associated with Kaposi's sarcoma, non-Hodgkins lymphoma and other malignancies; human papillomavirus is associated with invasive cervical cancer, cervical intraepithelial neoplasia and carcinomas of the vulva and penis.
37 This is the case for those with HIV and syphilis.
38 Forrest and Singh, 1990.
39 Forrest and Singh, 1990.
40 The Alan Guttmacher Institute, 1990c.

Some 25 percent of women and 19 percent of men who reported having had more than one partner in the past year did not answer the question about having had sex with a casual date or pickup. Of those who reported having had more than one partner and who did answer the question, 17 percent of women and 41 percent of men reported having had sex with a casual date or pickup.

41 The Alan Guttmacher Institute, 1990c.

Proportions are among women, or men, who have had intercourse within the past 12 months.

42 Hardy, 1984; Begley et al., 1989.
43 Potterat et al., 1987; B. Cannon and W. Cates, personal communication, 1989.
44 Hooper et al., 1978; B. Cannon and W. Cates, personal communication, 1989.
45 Aral and Holmes, 1990.
46 Johnson et al., 1989.
47 Lee et al., 1985; Aral and Holmes, 1990.
48 Aral and Holmes, 1990.
49 "Racial differences in rates . . . ," 1989.
50 Hahn et al., 1989.
51 Stone et al., 1986.
52 Hart, 1974; McCormack et al., 1973.
53 Austin et al., 1984; Quinn and O'Reilly, 1985; Bradbeer et al., 1988; Magder et al., 1988, Rosenberg, 1989.
54 Stone et al., 1986; Chantler, 1989.
55 Rosenberg et al., 1987; Jick et al., 1983; Rendon et al., 1980; Austin et al., 1984; Louv et al., 1988.
56 Austin et al., 1984.
57 Rein and Müller, 1990.
58 Apisarnthanarax et al., 1974; Davidson and Oates, 1985; Sobel, 1985.
59 Royal College of General Practitioners, 1978.
60 Washington et al., 1985a; Louv et al., 1989; Aral and Holmes, 1990.
61 Weström and Mårdh, 1990.
62 Platt et al., 1983; Barnes and Holmes, 1984.
63 Wølner-Hanssen et al., 1990.
64 The total number of episodes is estimated to be four times the number of hospital admissions tabulated from the 1987 National Hospital Discharge Survey (E. Galaid, personal communication, 1990).
65 The rate of hospital admission for PID per 100,000 women aged 15–44 for 1987, based on unpublished tabulations of the 1987 National Hospital Discharge Survey, is multiplied by four to obtain an estimate of the rate of all PID episodes—ambulatory plus hospital admissions (E. Galaid, personal communication, 1990). The rate assumes that no woman had more than one episode of PID during the year. The rate was then divided by .885, the proportion of women who have ever had sex, as estimated from the 1988 National Survey of Family Growth (Forrest and Singh, 1990), to obtain the PID rate among all women in the U.S. population who have ever had sex.
66 Burkman et al., 1976, Heisterberg et al., 1986; Plummer et al., 1987; Williams et al., 1987; Heitmann and Benrubi, 1989.
67 Kelaghan et al., 1982; Wølner-Hanssen et al., 1990.
68 Kelaghan et al. (1982) give relative risks of 0.6, 0.4 and 0.7 for the condom, the diaphragm and spermicides, respectively, relative to nonusers of any method; Wølner-Hanssen et al. (1990) show 0.5, 0.3 and 0.9, for the condom, the diaphragm and foam or the sponge, respectively, relative to nonusers of any method. Neither study is large enough to determine whether the differences between methods are statistically significant.

For the calculations in this chapter, we applied relative risks of 0.5, 0.4, 0.4 and 0.6 for condom, diaphragm, sponge and spermicide users, respectively. These differing risks, combined with the different failure rates, resulted in estimates of upper genital tract infection that differed markedly between these four methods. In addition, our estimates suggested that women whose partners use condoms experience higher rates of upper genital tract infection than women who use the diaphragm or sponge. Since the estimates of relative risks and of failure rates for these four methods are based on studies that do not fully take into account demographic and behavioral differences between the users who choose the methods, and because available studies have been able to show no significant difference between the methods, we present the results for barrier and spermicide methods combined as an unweighted average of the estimates for the condom, the diaphragm, the sponge and spermicides.

69 Rubin et al., 1982; Wølner-Hanssen et al., 1990; Washington et al., 1985a,b; Kelaghan et al., 1982.

Because oral contraceptives have been associated with an increased detection of cervical chlamydia (Aral and Holmes, 1990), there has been much debate about whether oral contraceptive use is associated with a lowered or raised risk of PID due to chlamydia (Washington et al., 1985a). Available data are sparse. They suggest a lowered risk of chlamydial PID, but not gonococcal PID, in oral contraceptive users (Wølner-Hanssen et al., 1990) and a less-severe clinical course when oral contraceptive users have chlamydial PID (Svensson et al., 1984). We chose to rely on available studies that use population-based controls. These point to a lowered risk of PID in oral contraceptive users but do not separate infections due to chlamydia from those due to other organisms.

70 Valid data are sparse (Edelman, 1986; Philips and d'Ablaing, 1986; Vermesh et al., 1987; Keith, 1987).
71 Long-acting hormonal methods presumably act in the same way as oral contraceptives, by thickening cervical mucus, making it less penetrable to spermatozoa and pathogens. Vasectomy eliminates the presence of spermatozoa, and withdrawal greatly reduces the number of spermatozoa present. If spermatozoa are indeed vectors, transporting pathogens to the upper genital tract, these methods of birth control should protect against PID. However, because data on the relative risk of PID in women relying on these methods are insufficient, we have not included these methods in

Figure 7.2.

72 Lee et al., 1983. The authors report risks of PID ranging from 1.1 to 1.7 after the first month of use for IUD users relative to women using no method. However, none of these values were statistically significant. We chose an average value of 1.4 for the relative risk of PID among IUD users in the months following insertion (see note to Figure 7.2).

73 In the simulation models, we assumed that women are not at risk of upper genital tract infection during the 12 months of pregnancy and postpartum amenorrhea or during the three months allocated for ectopic pregnancies and pregnancies that end in spontaneous or induced abortions (see appendix A). There are no studies to support this assumption, but we believe that any risk would be very small, in part because of the protective effects of pregnancy.

74 The estimated 1987 ectopic pregnancy rate per 100,000 women who have ever had intercourse is calculated by dividing the number of ectopics in that year—88,000 (Centers for Disease Control, 1989)—by the total number of U.S. women aged 15–44 in 1987 (Hollmann, 1990), and dividing this rate by the proportion of women who have ever had intercourse—88.5 percent—as estimated from the 1988 National Survey of Family Growth (Forrest and Singh, 1990). The proportion of pregnancies that are ectopic is calculated as the ratio of the estimated number of ectopic pregnancies in 1987 to the total number of pregnancies in that year—6.3 million (see note to Figure 2.6).

75 Sherman et al., 1988.

76 Marchbanks et al., 1988.

77 Correy et al., 1988; Taylor, 1988.

78 Chow et al., 1987; Chung et al., 1982; Daling et al., 1985a; Holt et al., 1989.

79 Various techniques of tubal sterilization have slightly different failure rates; some with lower failure rates are associated with a higher likelihood of ectopic pregnancy when they do fail (H. Peterson, personal communication, 1990). As a result, the difference between methods of tubal sterilization in the ectopic rate per 100,000 sterilized women may not be large (not shown).

80 See appendix B.

81 Collins et al., 1984.

82 World Health Organization, 1987.

83 Mosher and Aral, 1985.

84 Moore and Cates, 1990.

85 Taylor, 1988.

86 Daling et al., 1985b; Burkman et al., 1988.

87 These numbers, which stem from our estimates of the effect of pill use on the risk of PID, contrast with findings of Cramer et al. (1987), who showed no protection by oral contraceptives against tubal infertility and even a slightly increased risk associated with their use. The Cramer et al. study, however, compared women who had tubal infertility with a control group of women undergoing delivery. This control group was not an entirely appropriate one to use to estimate the effects of pill use on tubal infertility, since oral contraceptive users are less likely to become pregnant than are users of most other methods and would therefore be underrepresented among women entering a hospital for delivery. We would have been hesitant to present the estimates shown in this chapter if the findings of Cramer et al. had been based on a control group that is more likely to represent the distribution of oral contraceptive use in the population. Nevertheless, we urge caution in interpreting these low estimates of tubal infertility associated with oral contraceptive use until more direct evidence becomes available from population-based studies.

88 Studies have shown that IUD use has virtually no effect on the risk of tubal infertility once PID is taken into account (Daling et al., 1985b; Cramer et al., 1985; Andolsek et al., 1986).

89 Dawson, 1990.

90 National Cancer Institute, 1989.

91 National Cancer Institute, 1989.

92 Schlesselman, 1989; Prentice and Thomas, 1987.

93 Schlesselman, 1989.

94 La Vecchia et al., 1984; Booth et al., 1989.

95 This estimate assumes a relative risk of 0.6 for ever-use of oral contraceptives (Prentice and Thomas, 1987; Schlesselman, 1989).

96 Schlesselman, 1989.

97 Booth et al., 1989; Centers for Disease Control, 1983; Cramer et al., 1982.

98 National Cancer Institute, 1989.

Women who have had a hysterectomy are not at risk. Since many U.S. women have had a hysterectomy, the rate among women who have not is somewhat higher than the overall rate. Because a woman choosing a contraceptive does not know whether she will have a hysterectomy in the future, all the estimates in this chapter are based on the incidence of cancer diagnosis among all women.

99 De Waard, 1982.

100 Henderson et al., 1983.

101 Schlesselman, 1989.

102 Schlesselman, 1989.

103 National Cancer Institute, 1989.

104 Schlesselman, 1989.

105 Prentice and Thomas, 1987; Schlesselman, 1989.

106 Prentice and Thomas, 1987.

107 Dawson, 1990.

108 Wingo et al., 1990.

109 Wingo et al., 1990.

110 Harlap (forthcoming).

111 Paul et al., 1986.

112 United Kingdom National Case-Control Study Group, 1989.

113 Meirik et al., 1986.

We could not include the Scandinavian study, which did not involve large numbers of women, in Figure 10.4 because age-specific results are not available.

114 World Health Organization, 1989a.

We did not include the World Health Organization study in Figure 10.4 because it involved very few long-term users.

115 Romieu et al., 1989.

The pill was not available in the United States when the women in this study were young; therefore, these women are not comparable to those represented in Figure 10.4.

116 Some scientists are concerned that the increased relative risks of breast cancer currently seen at young ages (i.e., in cohorts of women who used oral contraceptives in their teens and early 20s) will persist as the cohorts age. If this happens, the added risk of breast cancer among women who ever used the pill will be considerably larger than the estimates shown in this chapter. However, results of an analysis of data from the CASH study (Wingo et al., 1990) strongly suggest that this is not the appropriate interpretation of currently available studies.

117 Skegg, 1988.

118 Bruzzi et al., 1988.

119 None of the studies of pill use and breast cancer have taken into account potential effects of a recent pregnancy, and most have not considered whether reduced lifetime duration of lactation might explain their findings in long-term pill users.

120 Thomas, 1989.

121 A multicenter, international study by the World Health Organization (1989c) found no such effect. It is unclear whether this finding indicates a lower (or absent) risk of liver cancer associated with low-dose pills, a difference between developing and developed countries or an insufficient number of long-term users in the study.

122 National Cancer Institute, 1989.

The annual incidence of liver cancer per 100,000 women is approximately 0.2 at ages 15–34; 0.5 at ages 35–39; and 1.0 at ages 40–54.

123 We applied a relative risk of 2.5 for ever-use of the pill, and risks of 1.0, 2.0, 4.0 and 8.0, respectively, for the following durations of use: years 1–2, year three, years 4–7 and years eight or more (Thomas, 1989).

124 Alter et al., 1986.

125 Prentice and Thomas, 1987.

126 World Health Organization, 1989b.

127 National Cancer Institute, 1989.

In this book, when we refer to cervical cancer, we are referring only to invasive cervical cancer; we are not including carcinoma in situ, otherwise called cervical intraepithelial neoplasia.

128 Since many U.S. women have had hysterectomies that have removed their cervix, the rate among women who have not had a hysterectomy is somewhat higher than the overall rate. Because a woman choosing a contraceptive does not know whether she will have a hysterectomy in the future, all the estimates in this chapter are based on the incidence of cancer diagnosis among all women.

129 Bosch and Muñoz, 1989; Reeves et al., 1989; Stevenson and McNab, 1989.

130 Brinton and Fraumeni, 1986; Cramer, 1982.

131 Skegg et al., 1982; Zunzunegui et al., 1986; Slattery et al., 1989.

132 Brinton and Fraumeni, 1986; Parazzini et al., 1989a,b.

133 Layde and Broste, 1989; Winkelstein, 1990.

134 Mandelblatt, 1989; Battista and Grove, 1988.

135 This estimate assumes a relative risk of 0.5 for ever-users of barrier or spermicide methods. Brinton and Fraumeni, 1986; Celentano et al., 1987; Parazzini et al., 1989a; Slattery et al., 1989; Mori and Miyake, 1987.

136 Swan and Brown, 1979; Harris and Scott, 1979.

137 Vessey and Grice, 1989.

138 Peters et al., 1986; Celentano et al., 1987; Irwin et al., 1988; Parazzini et al., 1988, 1989b.

139 Brinton et al., 1986.

140 In all of our calculations, we assumed that the pill does not influence the incidence of invasive cervical cancer.

141 Bracken et al., 1984; Bracken, 1987; Berkowitz and Goldstein, 1988; Brinton et al., 1986.

142 Bracken, 1988; Atrash et al., 1986; Cohen et al., 1979; Kiel, 1986.

143 Twenty to 33 percent have postmolar trophoblastic disease (Curry et al., 1989; Berkowitz and Goldstein, 1988), but not all are treated with chemotherapy. In other countries where different criteria are used, a smaller proportion receive chemotherapy (Bagshawe et al., 1986; Duff, 1989).

144 We assumed the incidence of molar pregnancy to be 1.0 per 1,000 pregnancies at ages 15–19, 0.9 per 1,000 at 20–34, 1.5 per 1,000 at 35–39 and 3.0 per 1,000 at 40–44 (Bracken et al., 1984; Bracken, 1987; Kiel, 1986; Bagshawe et al., 1986; Chattopadhyay et al., 1988; Egwuatu and Ozumba, 1989). We assumed that the relative risk of a molar pregnancy is 2.0 for pregnancies resulting from a failure of periodic abstinence, withdrawal or oral contraceptives, and that the relative risk associated with all other methods is 1.0 (Buckley et al., 1988; Brinton et al., 1989). The probability of needing chemotherapy if a molar pregnancy occurs was taken as 0.15 below age 35, as 0.2 at ages 35–39 and as 0.5 at ages 40–44 (Kashimura et al., 1986; Teoh, 1988; Bahar et al., 1989; Hara et al., 1986). For women at each age, we assumed that an additional 2.5 cases of choriocarcinoma not associated with hydatidiform moles would develop per 100,000 pregnancies (Lederman et al., 1987).

145 Brinton et al., 1986; Parazzini et al., 1989a,b.

146 D. B. Thomas, personal communication, 1987.

147 Weiss, 1988.

148 De Waard, 1982.

149 Kelsey, 1979.

150 Bruzzi et al., 1988; Layde et al., 1989.

151 Byers et al., 1985; Layde et al., 1989.

152 But this is debated (see Cramer et al., 1983; Risch et al., 1983; Mori et al., 1987; Wingo et al., 1987; Booth et al., 1989).

153 These substances include proteases and antiproteases in secretions from seminal vesicles and the prostate.

154 This may be true if spermatozoa contribute to the etiology of cervical cancer.

155 Booth et al., 1989; Irwin et al., 1988; Mori et al., 1987.

156 Another hypothesis is that surgery may affect the blood or lymph supply to the ovary in some beneficial way.

157 World Health Organization, 1986.

158 World Health Organization, 1986; Lee et al., 1987; Paul et al., 1989; Higgins et al., 1985.

159 Rosenberg et al., 1990b; Mettlin et al., 1990; Guess, 1990.

160 In addition, while no cancer is trivial, women may fear some types more than others. Potential disfigurement from breast cancer may be more disturbing than the greater likelihood of mortality from ovarian cancer; or the possibility of a malignant disease may be more disturbing to younger women than to older women. Certain methods of decision analysis address the different values that women may put on various health outcomes; such an analysis is beyond the scope of this book.

161 National Cancer Institute, 1989.

162 National Cancer Institute, 1989.

163 Sartwell and Stolley, 1982; Stadel, 1981a,b.

164 Stolley et al., 1989.

165 Porter et al., 1985; Böttiger et al., 1980; Vessey et al., 1989; Croft and Hannaford, 1989; Stampfer et al., 1988.

166 Thom, 1987; Dismuke and Wagner, 1986; Klag et al., 1989.

167 Eaker et al., 1987; Johansson et al., 1983.

168 For instance, intracerebral hemorrhage and rheumatic heart disease do not appear to be related to pill use. Whether pill use affects cardiomyopathies is unknown.

169 Eaker et al., 1987.

170 These adjustments are extremely crude; they do not vary by age, even though the prevalence of risk factors rises with age, because of the paucity of data on the prevalence of predisposing factors among women in the United States, especially among smokers and nonsmokers who use the pill (see notes to Figures 11.1–11.3).

171 In reviewing the literature on oral contraceptives and cardiovascular disease, we found that comparison groups differ from study to study, variously including users of specific other methods, all nonusers who are not pregnant and all nonusers, both pregnant and nonpregnant. We chose to use the term "nonusers" to represent the comparison group of all other women in an age-group. Our estimates are intended to reflect the experience of those women at risk of unintended pregnancy who are not using the pill.

172 Eaker et al., 1987; Rosenberg et al., 1985.

173 Dyken et al., 1984.

174 The incidence and number of deaths due to nonhemorrhagic stroke were calculated in the same manner as those for the other three cardiovascular diseases discussed in this chapter. For details, see notes to Figures 11.1–11.3. We assumed that the risk of nonhemorrhagic stroke among pill users, relative to that among nonusers, was the same as that for myocardial infarction.

Whether smoking is an independent risk factor for nonhemorrhagic stroke has long been a subject of controversy; a recent meta-analysis has concluded that it is (Shinton and Beevers, 1989; see also Gill et al., 1989). The evidence that smoking and oral contraceptive use each independently increases the risk of nonhemorrhagic stroke is conclusive, but whether they also *interact* to affect the risk of this group of conditions is not known; thus, we have not given estimates for smoking and pill use combined. Even if these factors do not interact, the attributable risk will rise—as it does in venous thrombosis and embolism—with heavy smoking, pill use and age. Calculations of total cardiovascular disease incidence and mortality include an arbitrary assumption that there is an interaction.

175 Petitti et al., 1979; Yarnell et al., 1983; Belch et al., 1984; Ballelsen et al., 1985.

176 Royal College of General Practitioners, 1978; Vessey and Doll, 1969; Lawson et al., 1977; Petitti et al., 1979; Stadel, 1981a.

However, because both pill use and smoking independently raise the risk of venous thrombosis and embolism at each age, relative to the risk in nonusers, and because the risk in nonusers rises slightly with age, the added effects of pill use and smoking increase with age.

177 Sartwell and Stolley, 1982.

178 Thompson et al., 1989.

There is less consensus about residual effects of past pill use on strokes than about myocardial infarction and venous thrombosis and embolism (Stadel, 1981a,b; Stampfer et al., 1988; Stolley et al., 1989; Croft and Hannaford, 1989).

179 Rosenberg et al., 1990a.

180 Meade et al., 1980.

181 Stolley et al., 1989; Vessey et al., 1989; Croft and Hannaford, 1989; Böttiger et al., 1980; Stampfer et al., 1988; Porter et al., 1982; Porter et al., 1985.

182 Forrest, 1990.

183 World Health Organization, 1989d.

184 World Health Organization, 1988.

185 Eaker et al., 1987.

186 The evidence is mainly anecdotal and refers to venous thrombosis and embolism and cardiomyopathy. See Villasanta, 1965; Bergqvist et al., 1983; Letsky and de Swiet, 1984; Rochat et al., 1988.

187 Rochat et al., 1988.

188 Perlman et al., 1988; Croft and Hannaford, 1989; Green et al., 1988; Beral, 1985.

189 Unfortunately, no appropriate data exist, stratified by smoking status, that can be used to compare the incidence of cardiovascular disease during pregnancy with that during pill use. Even the risk of cardiovascular disease among pregnant women relative to that among nonpregnant women is unknown, because studies usually exclude women who are pregnant or have recently given birth.

190 In this chapter, we show the difference between the incidence of a specific condition among current users of a method and the incidence of that condition among all other women at risk of unintended pregnancy. For example, Figure 12.1 shows that users of periodic abstinence avoid 45 hospital admissions for ectopic pregnancy per 100,000 users, which means that 100,000 users of periodic abstinence experience 45 fewer admissions for ectopic pregnancy than do 100,000 other women at risk of unintended pregnancy. In earlier chapters, on the other hand, we presented absolute rates for each method in the figures, and sometimes stated the differences between users and nonusers in the text.

191 Forrest and Singh, 1990.

192 Lawson et al., 1989.

193 We arbitrarily assumed that 15 percent of spontaneous abortions would require hospitalization.

194 Gold et al., 1987.

195 Bruce, 1988.

196 Gold et al., 1987.

197 National Center for Health Statistics, 1989b.

198 Gold et al., 1987.

199 These numbers of pregnancies and abortions were calculated from age-specific models of the experience of women using no method and terminating all pregnancies with induced abortion, as described in appendix A.

200 Hakim-Elahi et al., 1990.

201 See note to Figures 12.1–12.6 for information on how estimates presented in this chapter were calculated.

202 The figures in this chapter are based on the assumption that half of pregnant women who do not have ectopic pregnancies or spontaneous abortions will choose abortion

and half will choose birth, because data show that U.S. women faced with an unintended pregnancy do choose birth and abortion in approximately equal proportions (Forrest and Singh, 1990). Although women relying on periodic abstinence may differ from others in their choice of abortion or birth following contraceptive failure, the purpose of the calculations in this chapter—and throughout the book—is to compare methods, while holding constant all other characteristics of the women. This is the only fair way to compare the health effects of different contraceptive methods.

If all women chose to terminate unintended pregnancies by abortion, then each year, 100,000 women using periodic abstinence would undergo an estimated 1,150 more induced abortions than 100,000 other women, and would have about one hospital admission more per 100,000 for treatment of their complications. But if all women chose to continue their pregnancies, users of periodic abstinence would have about 544 more cesarean deliveries per 100,000 women than others each year.

203 Since these hypothetical effects of withdrawal have not been investigated, we have not produced a figure to compare health risks and benefits of using this method.

204 Fihn et al., 1985; Hsiao, 1986; Strom, 1987.

205 Wright et al., 1978.

206 Austin et al., 1984; Bradbeer et al., 1988; Magder et al., 1988; Rosenberg, 1989.

207 Kelaghan et al., 1982; Wølner-Hanssen et al., 1990.

208 Austin et al., 1984.

209 About 16 percent of pregnancies following failure of the progestin IUD are ectopic (Tatum and Schmidt, 1977). Following failure of the copper IUD, about three percent of pregnancies are ectopic (I. Sivin, personal communication, 1990).

210 Bergqvist and Rybo, 1983; Larsson and Fianu, 1983; Andrade and Orchard, 1987; McCarthy et al., 1984.

211 Soderstrom, 1983.

However, there is no proof that the progestin IUD is associated with a lower risk of PID than the copper IUD.

212 See "upper genital tract infection" in note to Figures 12.1–12.6.

213 Ory et al., 1983.

214 See "benign breast disease" in note to Figures 12.1–12.6.

215 Ory and the Boston Collaborative Drug Surveillance Programme, 1974; Grimes and Hughes, 1989.

216 Ross et al., 1986.

217 Royal College of General Practitioners, 1974.

218 Omran and Standley, 1981.

219 Workdays lost were calculated assuming 13 cycles per year with one lost day per cycle for 10 percent of women, multiplied by 250 and divided by 365 (the probability that any particular day will be a workday).

220 Petitti et al., 1988.

221 A recent multicenter study (World Health Organization, 1989d) showed one percent of pill users in industrialized countries developing hypertension during their first year of use. However, this study also included pill preparations with higher doses of estrogen (e.g., 50 mcg ethinyl estradiol) and progestin (e.g., 250 mg levonorgestrel) than are generally used now in the United States. In 1988, for example, 76 percent of American women using oral contraceptives used pills with 35 mcg of estrogen or less (Forrest, 1990).

222 Forrest, 1990.

223 Population Information Program, 1987.

224 Royal College of General Practitioners, 1978.

225 Hull, 1983; McCann et al., 1989; Diaz et al., 1984.

226 Sivin, 1988.

227 World Health Organization, 1978.

228 World Health Organization, 1986; Lee et al., 1987; Paul et al., 1989.

229 Smith et al., 1985; Ross et al., 1985; Peterson et al., 1990; Franks et al., 1987.

Other than postoperative complications to men of the vasectomy procedure, the health risks and benefits shown in Figure 12.6 are for women.

230 Tatum and Schmidt, 1977.

231 National Center for Health Statistics, 1990.

232 National Center for Health Statistics, 1990.

The actual number of maternal deaths is estimated to be about one-third higher than the number reported by the National Center for Health Statistics (Rochat et al., 1988); the maternal mortality rates presented here are therefore inflated by 33 percent.

233 See note to Figure 13.2.

234 We have arbitrarily assumed the mortality rate from PID is approximately three per 100,000 episodes; no data are available.

235 Peterson et al., 1990; see also Ross et al., 1985.

No recent summary is available of the risk of vasectomy in the United States or anywhere else; the estimate we used is a very rough one.

236 The most recent data on mortality associated with all methods of tubal sterilization are a decade old (see Ross et al., 1985); the estimate we used is a very rough one.

237 We have not estimated the number of deaths from HIV infection prevented by use of barrier and spermicide methods. While the issue is extremely important, many research questions are still outstanding and more comprehensive treatments of the subject are being worked on by others (see Alexander et al., 1990).

CHAPTER TWO

2.1 Forrest and Singh, 1990.

2.2 Forrest and Singh, 1990.

The percentages of women who have had sex in the past three months, by five-year age-group (15–19 through 40–44), are, respectively, 42.5, 75.8, 85.4, 88.2, 86.5 and 84.3. The percentages who have ever had sex, but not in the past three months, are, respectively, 10.7, 10.6, 9.4, 9.8, 11.4 and 14.6.

2.3 Estimated as the proportion of women who are noncontraceptively sterile (Forrest and Singh, 1990).

2.4 Forrest and Singh, 1990.

The percentages of women who are pregnant or postpartum (gave birth within the last two months), by five-year age-group (15–19 through 40–44), are, respectively, 3.2, 6.7, 9.2, 6.1, 1.7, 0.3; the percentages seeking pregnancy are, respectively, 1.1, 4.3, 5.3, 6.2, 3.1 and 1.6.

2.5 The Alan Guttmacher Institute, 1990a.

Of all women, the percentages at risk of unintended pregnancy and who do not intend to have more children, by five-year age-group (15–19 through 40–44), are, respectively, 4.6, 11.9, 28.8, 51.4, 66.9 and 70.0; the percentages of women who are at risk of unintended pregnancy and who intend to have more children are, respectively, 36.2, 55.3, 43.3, 22.0, 7.9 and 1.6.

2.6 Stanley Henshaw of The Alan Guttmacher Institute (AGI) provided estimates of the numbers of intended and unintended births and of abortions from pregnancies conceived in 1987, by women's age at time of conception. He obtained the number of births occurring between July 1987 and June 1988 among women in five-year age-groups from vital statistics (National Center for Health Statistics, 1989a); the number of abortions occurring in 1987 among women in five-year age-groups are based on Henshaw's calculations using AGI abortion surveys and Centers for Disease Control estimates. Births that occurred between July 1987 and June 1988 were used rather than births in 1987 to match more closely the times of conception for pregnancies that ended in abortion in 1987. The distributions of births and of abortions according to the ages of the women were adjusted to approximate the women's age at time of conception rather than their age at the time of the birth or abortion.

The distribution of pregnancies leading to live births by intention status was assumed to be the same as the distribution among women in the 1988 National Survey of Family Growth (see Forrest and Singh, 1990). All abortions were assumed to be the outcome of unintended pregnancies.

Using these estimates of intended births (total number of births minus estimated number of unintended births), unintended births and abortions, we calculated the total number of intended pregnancies and unintended pregnancies. To do so, we assumed that for every woman who had a live birth or induced abortion, a fixed proportion of other women also became pregnant but had spontaneous abortions. We therefore calculated the number of spontaneous abortions that occurred among each of three groups of women: those who would have had an intended birth, those who would have had an unintended birth and those who would have had an induced abortion. We obtained these numbers by applying age-specific risks of spontaneous abortion as given in appendix A.

Because we used age-specific estimates of spontaneous abortion, our estimates of the total numbers of pregnancies differ from those of Forrest and Singh (1990), who also used the Henshaw data but applied an overall estimate of spontaneous abortion.

2.7 See note to Figure 2.6.

Per 1,000 women, the numbers of intended pregnancies, according to women's age at conception, by five-year age-group (15–19 through 40–44), are, respectively, 23.5, 75.1, 86.4, 55.7, 17.2 and 2.2; the numbers of unintended pregnancies are, respectively, 99.5, 112.9, 69.6, 39.4, 20.7 and 6.3.

2.8 See note to Figure 2.6.

Per 1,000 women, the numbers of intended births, according to women's age at conception, by five-year age-group (15–19 through 40–44), are, respectively, 20.5, 66.2, 75.7, 46.9, 13.2 and 1.3; the numbers of unintended births are, respectively, 43.4, 49.8, 32.8, 17.1, 7.5 and 1.7; the numbers of induced abortions are, respectively, 45.5, 51.9, 29.5, 17.1, 9.2 and 2.5; and the numbers of spontaneous abortions are, respectively, 13.5, 20.1, 18.0, 14.0, 7.9 and 3.1.

2.9 See note to Figure 2.6.

The percentages of unintended pregnancies that end in births, according to women's age at conception, by five-year age-group (15–19 through 40–44), are, respectively, 43.7, 44.1, 47.1, 43.3, 36.4 and 26.8; the percentages that end in induced abortions are, respectively, 45.7, 46.0, 42.4, 43.5, 44.6 and 38.9; and the percentages that end in spontaneous abortions are, respectively, 10.6, 9.9, 10.5, 13.2, 18.9 and 34.3.

CHAPTER FOUR

4.1–4.4 The Alan Guttmacher Institute, 1990a. Figure 4.1. An additional 0.2 percent of women aged 15–44 at risk of unintended pregnancy in 1988 were using other methods.

4.2 All women in the sterilization group rely on their partner's vasectomy.

4.4 The proportions using the sponge and other methods are not included.

CHAPTER FIVE

5.1 Proportion of women at risk who are using contraceptives—Forrest and Singh, 1990.

Proportion of unintended pregnancies to contraceptive users and nonusers—From the 1988 National Survey of Family Growth, we estimated that 43.7 percent of all unintended births occurring between January 1, 1984, and the date of interview followed conceptions during contraceptive use. Consequently, 56.3 percent of these births were to nonusers of contraceptives. We applied these proportions to the total number of unintended births conceived in 1987 (see note to Figure 2.6) to obtain the numbers of unintended births to contraceptive users and nonusers in 1987. Next we estimated the numbers of induced abortions in 1987 for these two groups by assuming that 51 percent of abortions are obtained by women who were using a contraceptive at the time they became pregnant (Henshaw and Silverman, 1988). Finally, we allocated the numbers of spontaneous abortions that had been estimated on the basis of the numbers of unintended births and induced abortions into those associated with contraceptive use and nonuse, according to the above proportions. The total number of unintended pregnancies among contraceptive users and among nonusers is therefore the sum of the births, spontaneous abortions and induced abortions allocated to each group.

5.2 See note to Figure 5.1.

Because of rounding, the total number of unintended pregnancies—3.5 million (see Figure 5.1)—differs from the sum of the numbers shown for nonusers and users (1.86 million and 1.67 million, respectively).

5.3 See appendix B, Table B.2.

The lowest and highest failure rates for each five-year age-group (15–19 through 40–44) are estimated as the lowest and highest pregnancy rates, respectively, among race and marital-status subgroups within each age-group. Low rates for each method for women aged 15–44 are calculated as an unweighted average of the lowest rate in each age-group; high rates, as an unweighted average of the highest rate.

5.4 See appendix B, Table B.2.

The lowest and highest failure rates for each five-year age-group (15–19 through 40–44) are estimated as the lowest and highest pregnancy rates, respectively, among race and marital-status subgroups within each age-group.

The pregnancy rate of 87.5 percent for women aged 25–34 using no method is an unweighted average of our estimates for women aged 25–29 (90.0 percent) and women aged 30–34 (85.0 percent). Similarly, the pregnancy rate for women aged 35–44 using no method is the unweighted average of 80.0 percent for women aged 35–39 and 70.0 percent for women aged 40–44.

Age-specific failure rates for implants, injectables, tubal sterilization and vasectomy are not shown because we assumed no age variation in the failure rate for these methods.

5.5 Calculated using simulation models run for 30 years (see appendix A), assuming low contraceptive failure rates (see Figure 5.3) and low risk of upper genital tract infection (discussed in chapter 7). We applied failure rates based on women's experience in their first year of use even though our simulation models were run for longer than one year (for 30 years in Figure 5.5 and for five years in all other figures based on the simulation models). Although it might seem preferable to assume that failure rates decline over time, we used first-year failure rates for the following reasons: Most studies have presented estimates of contraceptive failure only in the first year of use, and thus our understanding of the relations among rates for different methods is most refined for first-year rates. In addition, data are unavailable to estimate the rate at which the failure rate for each method declines over time. For most methods, first-year rates are not limited to the experience of women using the method for the first time—that is, some women will have used the method before. Finally, rates for longer durations of use, which are available from only a few studies, may represent the failure experience among a select group of women (those who are least likely to fail). By using failure rates for the first year of use and applying those rates to models that simulate the experience of women over longer durations of use, we may overestimate the number of contraceptive failures women

would have. However, the result would be to underestimate the benefits of contraceptive use that are linked to pregnancy prevention.

CHAPTER SIX

6.1 Centers for Disease Control, 1989.
6.2 The Alan Guttmacher Institute, 1990d.
6.3 The Alan Guttmacher Institute, 1990d.
6.4 B. Cannon and W. Cates, personal communication, 1989.
6.5 Age-specific gonorrhea rates among all women who have ever had intercourse are calculated as the 1987 age-specific gonorrhea rates (Centers for Disease Control, 1988) divided by the proportion of women in each age-group who have ever had intercourse, as estimated from the 1988 National Survey of Family Growth (Forrest and Singh, 1990).

CHAPTER SEVEN

7.1 Rates of hospital admission for PID per 100,000 women in five-year age-groups (15–19 through 40–44) for 1987, based on unpublished tabulations of the 1987 National Hospital Discharge Survey, are multiplied by four to obtain estimates of the rates of all PID episodes—ambulatory plus hospital admissions (E. Galaid, personal communication, 1990). The rates assume that no woman had more than one episode of PID during the year. We divided the rates for all women in the U.S. population by the proportion of women who had ever had intercourse, as estimated from the 1988 National Survey of Family Growth (Forrest and Singh, 1990).
7.2 Using SMLTREE (see appendix A), we calculated the annual numbers of upper genital tract infections—both PID and pregnancy-related infections—per 100,000 women relying on each method.

PID risk among nonusers—First, we obtained the rate of hospital admissions for PID for all women aged 15–44 based on unpublished tabulations of the 1987 National Hospital Discharge Survey and multiplied it by four to obtain an estimate of the rate of all PID episodes (E. Galaid, personal communication, 1990). We then divided this rate by the proportion of women who had had sex in the past three months and were not currently pregnant, as given in the 1988 National Survey of Family Growth (The Alan Guttmacher Institute, 1990a). The result is the annual rate of PID among currently sexually active, nonpregnant U.S. women—1,314 per 100,000 women. Second, from previous studies, we estimated the risk of developing PID for users of different contraceptives *relative to* that for women who use no method. To calculate a PID rate among nonusers from the rate for all women, we applied the following formula (Schlesselman, 1982), which requires the rate for all women, the proportion of women using contraceptives, and the relative risk of PID for those methods:

$$PID_{nonuser} = PID_{pop} / [(RR \ p_{user}) + (1-p_{user})]$$

where p_{user} is the proportion using oral contraceptives, barrier or spermicide methods, withdrawal or tubal sterilization in 1988; RR is the relative risk of PID among users of these methods (0.5); and PID_{pop} is the rate of PID for the entire population. Women relying on periodic abstinence or vasectomy are not included in p_{user} because their PID risk is presumably the same as that for nonusers. In addition, we ignored the contribution of IUDs and long-acting hormonal methods to simplify the calculation, because the proportion of U.S. women using these methods in 1988 was extremely small. Third, we obtained the absolute risk of PID for users of each of the methods by multiplying the relative risk for that method by $PID_{nonuser}$. To obtain the approximate monthly probabilities of developing PID, we divided the method-specific annual rates of PID by 12.

For nonusers, we estimated the annual baseline risk of PID to be 174.0 per 100,000 women. We assumed that the lowest risk of STD infection—and therefore the lowest risk of PID—is found among women in mutually monogamous relationships, and estimated the risk of PID among such women to be one-tenth of the baseline estimate. The annual rate we calculated among nonusers of contraceptives (17.4 per 100,000) is slightly higher than the rate of 14.0 per 100,000 nonusers of the IUD observed by Vessey et al. (1981) among married contraceptive users (nonusers of the IUD in the study by Vessey et al. included users of all other methods, some of which would lower the risk of PID). For women not in mutually monogamous relationships, we assumed that for each method and for nonusers, the PID rate is approximately three times the average rate. This is the risk observed by St. John et al. (1981) for separated women (those with the highest risk of PID in that study) relative to all women.

Effects of contraceptives on PID risk—Calculated assuming the following risks relative to the baseline rate for nonusers: periodic abstinence, 1.0; IUD, 4.0 in the first month, falling to 1.4 in the fourth month (Lee et al., 1983; SMLTREE provides interpolated values based on a linear decrease for the second and third months); oral contraceptives, 0.5 (Rubin et al., 1982; Wølner-Hanssen et al., 1990; Washington, 1985a,b; Kelaghan et al., 1982); tubal sterilization, 0.5 (Edelman, 1986; Philips and d'Ablaing, 1986; Vermesh et al., 1987; Keith, 1987). Estimates for barrier and spermicide methods are calculated as an unweighted average of model results for the condom (using a relative risk of 0.5), the diaphragm (0.4), the sponge (0.4) and spermicides (0.6) (see note 68 to text; Kelaghan et al., 1982; Wølner-Hanssen et al., 1990).

Pregnancy-related infections—Recent, reliable statistics, applicable to the United States on a national basis, are not available for risks of infection following childbirth and abortion. We therefore took, arbitrarily, overall rates of infection of 1.0 percent after childbirth and 0.25 percent after spontaneous abortions, and took a rate of 0.5 percent after induced abortions from Hakim-Elahi et al. (1990).

Studies looking at special, disadvantaged populations, such as inner-city black women, have found much higher levels of infection after induced abortion (Burkman et al., 1976; Heisterberg et al., 1986). Similarly, populations at high risk for STDs have high rates of endometritis following vaginal delivery (Plummer et al., 1987) and cesarean section (Williams et al., 1987; Heitmann and Benrubi, 1989). For estimates of the pregnancy-related infection rates of women in mutually monogamous relationships, we multiplied the overall rates following childbirth, spontaneous abortion and induced abortion by 0.2. For women not in mutually monogamous relationships, we multiplied the overall rates of infection by three. We assumed contraceptive use has no effect on these rates of infection, since contraception is not used during pregnancy.

CHAPTER EIGHT

8.1 No previous episodes of PID—We set the baseline probability of an ectopic pregnancy at two per 1,000 pregnancies (Vessey et al., 1979; Nadha Sarma et al., 1988).

One, two and three previous episodes of PID—Rates of ectopic pregnancy were obtained for women aged 15–24 from Weström and Mårdh (1990) and were applied at all ages.
8.2 No previous ectopics—We set the baseline probability of an ectopic pregnancy at two per 1,000 pregnancies (Vessey et al., 1979; Nadha Sarma et al., 1988).

One previous ectopic—Unweighted average of rates given in Lund (1955), Malkasian et al. (1958), Tuomivaara and Kauppila (1988), Thorburn et al. (1988) and Mäkinen et al. (1989).

Two or more previous ectopics—Uotila et al. (1989), adjusted from 60 percent to 55 percent because spontaneous abortions were underreported.
8.3 Estimates of the risk of ectopic pregnancy following contraceptive failure of the progestin IUD, progestin-only oral contraceptives and injectables (Depo-Provera) are from Tatum and Schmidt (1977). Estimates for the TCu 380A and implants (NORPLANT) are from I. Sivin (personal communication, 1990). The estimate for tubal sterilization is from Kjer and Knudsen (1989) and H. Peterson (personal communication, 1990).
8.4 Calculated using SMLTREE models (see appendix A) with the following assumptions: We set the baseline probability of ectopic pregnancy at two per 1,000 pregnancies (Vessey et al., 1979; Nadha Sarma et al., 1988). Following one, two and three or more episodes of upper genital tract infection or ectopic pregnancy, we applied baseline probabilities as shown in Figures 8.1 and 8.2. The proportion of pregnancies that would be ectopic following three or more ectopic pregnancies was arbitrarily assumed to be 75 percent.

We assumed that use of combined oral contraceptives (Tatum and Schmidt, 1977), withdrawal, vasectomy or barrier and spermicide methods has no influence on the probability that the pregnancy will be ectopic, while we arbitrarily assigned a risk to users of periodic abstinence of 1.5 times the baseline risk (Iffy, 1965), yielding an estimate of three per 1,000 for users of periodic abstinence with no prior PID or ectopic pregnancies. We set the ectopic rate for implants at 14 percent of conceptions, the rate for the copper IUD at three percent (I. Sivin, personal communication, 1990), the rate for injectables at 13 percent (Tatum and Schmidt, 1977) and the rate for tubal sterilization at 50 percent (Kjer and Knudsen, 1989; H. Peterson, personal communication, 1990). In this figure, we averaged the estimates for implants and injectables.

In cases where the method-specific probability of ectopic pregnancy exceeded the probability following previous ectopic pregnancy or upper genital tract infection, we applied the method-specific probability.

In all SMLTREE models, we do not include progestin-only oral contraceptives or progestin IUDs because there are no reliable estimates of their effects on the risk of upper genital tract infection and because few American women use them (Mosher, 1990; Forrest, 1990).

CHAPTER NINE

9.1 Rates are calculated using data from Weström and Mårdh (1990) for women aged 15–24 and are assumed to apply at all ages. Those with tubal infertility include both women infertile due to tubal occlusion and those infertile for other reasons. The estimates are based on data for women who have had PID and are trying to

conceive. We assumed the estimates are applicable as well to women who have had PID and are not trying to conceive.

9.2 One previous ectopic—Unweighted average of rates given in Tuomivaara and Kauppila (1988), Thorburn et al. (1988) and Mäkinen et al. (1989).

Two previous ectopics—Uotila et al., 1989. The estimates are based on data for women who have had an ectopic pregnancy and are trying to conceive. We assumed the estimates are applicable as well to women who have had an ectopic pregnancy and are not trying to conceive.

9.3 Calculated using SMLTREE (see appendix A), assuming the probabilities of PID and pregnancy-related infections described in the note to Figure 7.2, the probabilities of ectopic pregnancy described in the note to Figure 8.4, the probability of infertility following these events as described in the notes to Figures 9.1 and 9.2, that the probability of tubal infertility following more than three episodes of PID is the same as the probability following three (see Figure 9.1) and that the probability following three or more ectopic pregnancies is 0.50. At the start of the simulation, we assumed that all 100,000 women had never had an upper genital tract infection or an ectopic pregnancy.

Because of insufficient data, Figure 9.3 does not include estimates for long-acting hormonal methods or for withdrawal. In addition, estimates for both methods of voluntary sterilization—tubal sterilization and vasectomy—have been excluded.

CHAPTER TEN

10.1 National Cancer Institute, 1989.

10.2–10.4 and 10.6 We used the following formula to estimate cancer rates among never-users in each age-group:

$$r_{never\text{-}user} = r_{pop} / [(RR \ p_{user}) + (1-p_{user})]$$

where $r_{never\text{-}user}$ is the cancer rate in never-users; r_{pop} is the cancer rate among women in the age-group in the U.S. population in 1982–1986 (National Cancer Institute, 1989); RR is the age-specific relative risk of cancer diagnosis among ever-users of the method (i.e., the ratio of the risk among users to that among nonusers); and p_{user} is the proportion of all women in the age-group in 1988 who have ever used the method (The Alan Guttmacher Institute, 1990a).

We estimated proportions of women at ages 45–49 and 50–54 who had ever used the method from data given for ages 40–44 in the 1982 National Survey of Family Growth (The Alan Guttmacher Institute, 1990e). For other ages, 15–19 through 40–44, we used data from the 1988 National Survey of Family Growth (The Alan Guttmacher Institute, 1990a). The proportions of all women in each age-group who had ever used the method are as follows:

Age-group	Barrier or spermicide	Oral contraceptives
15–44	.639	.697
15–19	.390	.293
20–24	.611	.716
25–29	.707	.788
30–34	.707	.807
35–39	.722	.792
40–44	.673	.749
45–49	.699	.663
50–54	.699	.458

All calculations using duration of method use categories are made with the assumption that women used the method for the full years of use indicated.

10.2 We used (based on Schlesselman, 1989) a relative risk of ovarian cancer diagnosis of 0.6 for ever-use of the pill, and risks of 0.9, 0.8, 0.6, 0.5, 0.4 and 0.2, respectively, for the following durations of use: year one, year two, year three, years four or five, years 6–9 and years 10 or more.

10.3 We used (based on Schlesselman, 1989) a relative risk of endometrial cancer diagnosis of 0.5 for ever-use of the pill, and risks of 0.8, 0.6, 0.5 and 0.4, respectively, for the following durations of use: one year, two years, three years and four or more years.

10.4 United States—We obtained relative risks of breast cancer from Wingo et al. (1990) and P. Wingo (personal communication, 1990). To calculate rates among nonusers, we applied relative risks of 1.4, 1.1 and 0.9 for ever-use of the pill to women in age-groups 15–34, 35–44 and 45–54, respectively. To calculate rates among users, we applied the following risks at ages 15–34: 1.0 for the first year of use, 1.5 for years 2–3, 1.9 for years 4–5, 1.3 for years 6–9, and 1.4 for years 10 or more. At ages 35–44, we applied relative risks of 1.2 for year one, 0.9 for year two, 1.0 for years 3–7, 1.5 for years 8–9 and 1.1 for years 10 or more. At ages 45–54, we applied relative risks of 0.8 for years 1–3, 1.0 for years 4–7, 0.8 for years 8–9 and 0.9 for years 10 or more. Although the CASH study shows a significant effect of time since starting use but no significant effect of duration of use (based on tests for trend), we have shown calculations using the latter variable, to allow comparisons with the New Zealand and United Kingdom studies.

New Zealand—We used the risk of breast cancer diagnosis among nonusers calculated from the U.S. CASH study (Wingo et al., 1990) and based relative risks for pill users on Paul et al. (1986). At ages less than 35, we applied relative risks of 2.8, 1.6, 1.8 and 4.6, respectively, for the following durations of use: years 1–2, years 3–5, years 6–9 and years 10 or more. At ages 35–44, we applied relative risks of 0.90, 0.92, 0.87 and 0.84, respectively. At ages 45–54, we applied relative risks of 1.3, 0.81, 0.60 and 0.96, respectively.

United Kingdom—We used the risk of breast cancer diagnosis among nonusers calculated from the U.S. CASH study data and based the relative risks among users on the United Kingdom National Case-Control Study Group (1989). The relative risks were 0.95, 1.43 and 1.74, respectively, for years 1–4, 5–8 and nine or more of use.

10.5 Sums of the estimates from Figures 10.2–10.4 plus estimates for liver cancer (see notes 122 and 123 to text).

10.6 We assumed that the relative risk of cervical cancer diagnosis among all women who have ever used a barrier or spermicide method is 0.5. The relative risks are 0.8 for year one of use, 0.6 for year two, 0.4 for year three and 0.2 for years four or more (estimated from Brinton et al., 1986; Celentano et al., 1987; Parazzini et al., 1989a; Slattery et al., 1989).

10.8 Incidence of cancers—Estimates are based on the same data and methodology used in Figures 10.2–10.4 and 10.6. For this figure, however, estimates are for all ever-users rather than for those who used the method for 10 or more years. For this analysis, we assumed a relative risk of 1.0 for breast cancer because the risk of being diagnosed with breast cancer by age 55 does not differ between women who have and have not used the pill when all age-groups are considered together (Prentice and Thomas, 1987; Schlesselman, 1989). The estimated cumulative numbers of cancers diagnosed before age 55, per 100,000 women who have ever used a barrier or spermicide method are as follows: breast, 3,000; ovarian, 510; endometrial, 630; cervical, 340; and liver, 10. For those who have ever used oral contraceptives, they are as follows: breast, 3,000; ovarian, 300; endometrial, 320; cervical, 690; liver, 30. For those who have never used either type of method, they are as follows: breast, 3,000; ovarian, 510; endometrial, 630; cervical, 690; liver, 10.

Incidence of cancers leading to death within five years of diagnosis—We calculated these rates by multiplying the number of each type of cancer diagnosed per 100,000 women by the death rate for that type of cancer (one minus its survival rate) (National Cancer Institute, 1989).

The estimated cumulative numbers of cancers leading to death within five years of diagnosis, per 100,000 women who have ever used a barrier or spermicide method, are as follows: breast, 720; ovarian, 310; endometrial, 100; cervical, 110; liver, 10. For those who have ever used oral contraceptives, they are as follows: breast, 720; ovarian, 190; endometrial, 50; cervical, 230; liver, 30. For those who have never used either type of method, they are as follows: breast, 720; ovarian, 310; endometrial, 100; cervical, 230; liver, 10.

CHAPTER ELEVEN

11.1–11.3 There are no national measurements for women 15–44 of the incidence of any of the four cardiovascular conditions discussed in this book. Furthermore, both nonhemorrhagic stroke and venous thrombosis and embolism are extremely difficult to define and, sometimes, to detect. Therefore, we derived the numbers of women who experience a cardiovascular disease annually per 100,000 in each age-group from the age-specific mortality rates given by National Center for Health Statistics (NCHS) (1990).

Prior to any other calculations, we adjusted the reported mortality rates for myocardial infarction downward by 33 percent, as did Ory et al. (1983), to take into account that a proportion of cardiovascular deaths occur among women with predisposing factors that would contraindicate pill use (Porter et al., 1985). For two reasons, we decided not to adjust the estimated mortality rates for subarachnoid and nonhemorrhagic strokes and venous thrombosis and embolism. First, in NCHS data, some deaths from strokes and a majority of deaths from nonidiopathic venous thrombosis and embolism would have been classified under an underlying cause. Second, when we did calculate mortality rates using the correction factors—a 33 percent reduction for strokes (Ory et al., 1983) and an 80 percent reduction for venous thrombosis and embolism (Porter et al., 1985)—the resulting mortality rates were markedly inconsistent with the incidence rates published by Porter et al. and others (e.g., Eaker et al., 1987). Using no correction factor, we estimated incidence rates of strokes and venous thrombosis and embolism for nonsmokers who are not pill users—three and seven per 100,000 women aged 15–44, respectively—that are reasonably consistent with those of Porter et al.

We estimated the incidence of myocardial infarction and subarachnoid hemorrhage as four times the mortality rates associated with these events (Vessey et al., 1984; Croft and Hannaford,

1989). Because of lack of data on nonhemorrhagic stroke and venous thrombosis and embolism, and the problems defining these conditions, the factors applied to the mortality rates—10 and 100, respectively—were somewhat arbitrary and were based on medical judgment.

For each of the four conditions, we estimated the mortality rates among groups of women who do and do not use oral contraceptives, and who do and do not smoke, in the following way: First we calculated the proportion of the overall mortality rate for a specific condition that is attributable to excess mortality among women who use oral contraceptives or smoke using the formula given by Goldbaum et al. (1987). Similarly, we took from Goldbaum et al. the proportions of women in the U.S. population who use oral contraceptives and the proportions who smoke, whether lightly (1–24 cigarettes per day) or heavily (25 or more cigarettes per day). However, we used different estimates of the relative risks associated with pill use or smoking. The relative risks we used are discussed below for each condition. Second, having calculated p, the proportion of the total mortality rate that is attributable to women's oral contraceptive use and smoking, we estimated the proportion of the mortality rate that would remain if no women smoked or used the pill as 1–p. We calculated this proportion for age-groups 18–24, 25–34 and 35–44, because these were the age-groups given by Goldbaum et al. Third, to estimate the annual mortality rates for each group of cardiovascular diseases among women not using the pill and not smoking, we multiplied 1–p by the actual death rates reported among women in the U.S. population in the corresponding five-year age-groups in 1984–1986 (calculated from National Center for Health Statistics, 1990; and Hollmann, 1990). Fourth, to estimate the annual rates among pill users, smokers and combinations of the two groups, we multiplied the estimated rates among nonusers, nonsmokers by the appropriate relative risks (described below).

A value of zero for the number of deaths in these figures indicates that the estimate was less than 0.5.

11.1 A review of recent literature (Stolley et al., 1989) has suggested that the risk of cardiovascular disease associated with oral contraceptive use has decreased from the relative risks observed a decade ago. But reliable estimates of the current relative risks are not available. We therefore arbitrarily assumed that nonsmokers using the pill have a risk of myocardial infarction that is twice the risk among women who neither smoke nor take the pill. For the effects of smoking among women not using the pill, we relied on Rosenberg et al. (1985), who gave risks of 2.0 for light smokers and 4.8 for heavy smokers relative to the risk among nonsmokers. There are no recent data on the interaction between smoking and pill use. We therefore relied on Rosenberg et al. (1985). They reported that light and heavy smokers who use the pill have risks of 3.1 and 23.0 relative to the risk among nonsmokers who are pill users. Since we used a relative risk of 2.0 for pill use in nonsmokers, we also doubled the relative risks in smokers, to obtain risks of 6.2 and 46.0, respectively, for light and heavy smokers who are pill users, relative to the risks for women who neither smoke nor use oral contraceptives. We assumed that these relative risks applied equally at all ages.

For nonsmokers, the annual numbers of deaths from myocardial infarction per 100,000 women not using oral contraceptives, by five-year age-group (15–19 through 40–44), are, respectively, 0, 0, 0, 0, 1 and 3; and per 100,000 oral contraceptive users, 0, 0, 0, 1, 2 and 5, respectively.

For light smokers, the annual numbers of deaths per 100,000 women not using oral contraceptives, by five-year age-group (15–19 through 40–44), are, respectively, 0, 0, 0, 1, 2 and 5; and per 100,000 oral contraceptive users, 0, 0, 1, 2, 6 and 16, respectively.

For heavy smokers, the annual numbers of deaths per 100,000 women not using oral contraceptives, by five-year age-group (15–19 through 40–44), are, respectively, 0, 0, 1, 2, 4 and 12; and per 100,000 oral contraceptive users, 1, 2, 6, 16, 42 and 118, respectively.

11.2 We based our estimates for subarachnoid hemorrhage on the same assumptions about relative risks and interactions of pill use with smoking that we made for myocardial infarction (see note to Figure 11.1).

For nonsmokers, the annual numbers of deaths from subarachnoid hemorrhage per 100,000 women not using oral contraceptives, by five-year age-group (15–19 through 40–44), are, respectively, 0, 0, 0, 1, 1 and 2; and per 100,000 oral contraceptive users, 0, 0, 1, 1, 3 and 4, respectively.

For light smokers, the annual numbers of deaths per 100,000 women not using oral contraceptives, by five-year age-group (15–19 through 40–44), are, respectively, 0, 0, 1, 1, 3 and 4; and per 100,000 oral contraceptive users, 0, 1, 2, 4, 9 and 12, respectively.

For heavy smokers, the annual numbers of deaths per 100,000 women not using oral contraceptives, by five-year age-group (15–19 through 40–44), are, respectively, 0, 1, 2, 3, 7 and 9; and per 100,000 oral contraceptive users, 2, 6, 18, 29, 65 and 87, respectively.

11.3 In calculating estimates for venous thrombosis and embolism, we assumed that there is no interaction of the effects of smoking and pill use (Petitti et al., 1979; Stadel, 1981a,b). We assumed a relative risk of developing venous thrombosis and embolism of 3.0 for pill users, on the basis of the relative risk of 2.8 given by Porter et al. (1985) and a review of other literature (Stolley et al., 1989). We arbitrarily assumed relative risks of 2.0 and 7.0 for light and heavy smokers, respectively. Petitti et al. (1979) have reported relative risks of 3–4 for venous thrombosis and embolism in all smokers combined, but we found no reference separating light and heavy smokers at 25 cigarettes per day and either stratifying or controlling for pill use.

For nonsmokers, the estimated annual number of deaths from venous thrombosis and embolism is zero per 100,000 women regardless of oral contraceptive use or age-group.

For light smokers, the annual number of deaths is zero per 100,000 women in all groups except the oldest oral contraceptive users, among whom it is one per 100,000.

For heavy smokers, the annual numbers of deaths per 100,000 women not using oral contraceptives, by five-year age-group (15–19 through 40–44), are, respectively, 0, 0, 0, 0, 1 and 1; and per 100,000 oral contraceptive users, 0, 1, 1, 2, 2 and 3, respectively.

CHAPTER TWELVE

12.1–12.6 All the figures in this chapter show, for each specific health outcome, the difference per 100,000 women aged 15–44 between the incidence of a specific condition among users of the method and the incidence of that condition among all other women at risk of unintended pregnancy. We assumed that the distribution of methods used among the latter was that shown in Figure 4.1.

To calculate the rate of each outcome for "other women" ($r_{nonuser}$), we used the following formula:

$$r_{nonuser} = [\Sigma (r_{method} \ p_{method})] \ / \ (1-p_{user})$$

where r_{method} is the rate of the health outcome for each method or group of methods, including no method; p_{method} is the proportion of women at risk of unintended pregnancy using each method or group of methods; and p_{user} is the proportion of women at risk using the method of interest. The calculations in this chapter are for current users.

Pregnancies, spontaneous abortions, induced abortions and births—Calculated using SMLTREE (see appendix A), assuming low failure rates for the methods and a low risk of upper genital tract infection (see chapter 7). By using these assumptions, we minimized differences between methods in the numbers of pregnancies, spontaneous abortions, induced abortions and births that result from method differences in contraceptive failure or the risk of upper genital tract infections. On the basis of the assumption that equal proportions of unintended pregnancies in the United States end in birth and in abortion (Forrest and Singh, 1990), we averaged the results of two models for each method—one that assumed all nonectopic pregnancies not ending in spontaneous abortions continue to birth and one that assumed they end in induced abortion—to obtain the numbers of pregnancies, spontaneous abortions, induced abortions and births.

In these models, we set the probability of pregnancy for women using no method at 0.146 per month (corresponding to an annual probability of 0.85). For the birth models, we assumed that 15 percent of nonectopic pregnancies end in spontaneous abortions, and for the induced abortion models, that 10 percent end in spontaneous abortions (see appendix A).

Hospital admissions for spontaneous abortion—Calculated on the arbitrary assumption that 15 percent of spontaneous abortions lead to hospitalization.

Hospital admissions for complications of induced abortion—Calculated on the assumption that 0.07 percent of induced abortions are followed by complications serious enough to require hospital admission (Hakim-Elahi et al., 1990).

Hospital admissions for ectopic pregnancies—Calculated using weighted results from two SMLTREE models for each method (see appendix A): One assumes mutual monogamy (a low risk of STD), and the other assumes that women are not in mutually monogamous relationships. We obtained the number of ectopic pregnancies by adding 14 percent of the number of ectopics estimated in the nonmonogamous model to 86 percent of that estimated in the monogamous model. These are the estimated proportions of American women who do and do not have more than one sexual partner in a year, respectively (Forrest and Singh, 1990). For the IUD only, we assumed that all users were in mutually monogamous relationships, since IUD use is contraindicated for women with multiple partners. The result of this assumption is a lower estimate of ectopic pregnancy among IUD users than among women not using the IUD. This is because the comparison group—all women not using the IUD—includes nonmonogamous women (14 percent). If we were to restrict our comparison

group to monogamous women, IUD users would have approximately 26 per 100,000 more hospitalizations for ectopic pregnancy than women not using the IUD. For further explanation of our calculations of ectopic pregnancy, see chapter 8.

Hospital admissions for upper genital tract infection—Calculated from results given in chapter 7 (Figure 7.2), assuming 14 percent of the population are not in a mutually monogamous relationship, regardless of the method of contraception. This is the estimated proportion of U.S. women who have more than one sexual partner in a year (Forrest and Singh, 1990).

For the IUD only, we assumed that all users were in mutually monogamous relationships, since IUD use is discouraged among women with multiple partners. The result of this assumption is a lower estimate of upper genital tract infections among IUD users than among women not using the IUD (58 fewer hospital admissions per 100,000 women). This is because the comparison group—all women not using the IUD—includes nonmonogamous women (14 percent). If we were to restrict our comparison group to monogamous women, IUD users would have approximately 43 per 100,000 more hospitalizations for upper genital tract infections than women not using the IUD.

Hospital admissions for cesarean delivery—Estimated as 24.4 percent of births (National Center for Health Statistics, 1989b).

Hospital admissions for gallbladder disease—Increased in pill users only. The apparent decrease in rates of hospitalization for users of certain methods is due to the inclusion of pill users in the comparison group. We assumed a relative risk of 2.0 in the first year of pill use and of zero thereafter (Petitti et al., 1988). The incidence of hospital admissions for gallbladder disease was obtained from the 1987 National Hospital Discharge Survey (The Alan Guttmacher Institute, 1990b). First-year users constitute an estimated 27 percent of American women currently using oral contraceptives (The Alan Guttmacher Institute, 1990a).

Hospital admissions for cardiovascular disease—Calculated as in chapter 11, assuming one hospital admission for each event. An increased risk applies to pill users only. The apparent decrease in rates of hospitalization for users of certain methods is due to the inclusion of pill users in the comparison group. Unless events are shown separately, cardiovascular disease includes myocardial infarction, stroke and venous thrombosis and embolism.

Oral contraceptives are generally contraindicated for women who are over age 35 and smoke heavily—that is, 15 or more cigarettes per day (Hatcher et al., 1990). In our calculations, light smokers are defined as those who smoke 1–24 cigarettes per day, a category that overlaps with other definitions of light smoking (see chapter 11). Because women who are likely to have a steeply elevated risk of cardiovascular disease because of their smoking are generally excluded from oral contraceptive use, we have assumed that no pill users aged 35–44 smoke at all. Women aged 25–34 who are heavy smokers have rates of cardiovascular disease and mortality that are as high or higher than rates among women aged 35–44 who are light smokers (see chapter 11). We have also assumed that no pill users aged 25–34 are heavy smokers. On the basis of data from Goldbaum et al. (1987), we assumed that five percent of oral contraceptive users aged 15–24 smoke 25 or more cigarettes per day (heavy smokers), 40 percent smoke 1–24 cigarettes per day (light smokers) and 55 percent do not smoke, and that 21 percent of pill users aged 25–34 are light smokers and 79 percent are nonsmokers. We assumed that all women at risk of unintended pregnancy not using oral contraceptives smoke in the proportions reported by Goldbaum et al. for all nonusers of oral contraceptives—that is, that among women aged 15–24, five percent smoke heavily, 28 percent smoke lightly and 67 percent smoke not at all; among women aged 25–34, the distribution by smoking status is eight percent, 23 percent and 69 percent, respectively; and among women aged 35–44, it is 13 percent, 26 percent and 61 percent, respectively.

Hospital admissions for urinary tract infection—Increased in diaphragm users only. The apparent decrease in rates of hospitalization for users of other methods is due to the inclusion of diaphragm users in the comparison group. We assumed a relative risk of 2.5 for current diaphragm use (Strom, 1987; Hsiao, 1986). The incidence of urinary tract infection was calculated using data from the 1987 National Hospital Discharge Survey (The Alan Guttmacher Institute, 1990b), including hospital admissions for acute cystitis and for acute pyelonephritis (*International Classification of Diseases, 9th Revision* [*ICD-9*] codes 595.0 and 590.1, respectively [Department of Health and Human Services, 1980]).

Hospital admissions for invasive cancer—Includes cervical, ovarian, endometrial, breast and liver cancer combined, assuming that users of each method under consideration have never used any other method. For a description of the computations of cancer diagnosis estimates, see chapter 10. We assumed one hospital admission for each case. We applied cervical cancer rates for never-users of barrier and spermicide methods in the calculation of rates for users of no method, periodic abstinence, withdrawal, oral contraceptives, the IUD, tubal sterilization and vasectomy, and the rate for ever-users of barrier and spermicide methods in the calculation of rates for users of barrier and spermicide methods. We applied ovarian, endometrial, breast and liver cancer rates for never-users of oral contraceptives in the calculation of rates for users of no method, periodic abstinence, withdrawal, barrier and spermicide methods, the IUD and vasectomy, and the rate for ever-users of oral contraceptives in the calculation of rates for users of oral contraceptives. In the calculation of rates for tubal sterilization, we applied endometrial, breast and liver cancer rates for never-users of oral contraceptives and the ovarian cancer rate for ever-users of oral contraceptives.

Hospital admissions for cervical intraepithelial neoplasia—Calculated assuming a relative risk of 0.25 from ever-use of barrier or spermicide methods and no effects of other methods (Wright et al., 1978). The apparent increase in rates of hospitalization for users of certain methods is due to the inclusion of women using barrier and spermicide methods in the comparison group. The incidence of hospital admission for cervical intraepithelial neoplasia was estimated from the 1987 National Hospital Discharge Survey (The Alan Guttmacher Institute, 1990b).

Hospital admissions for ovarian cysts—Estimated from the 1987 National Hospital Discharge Survey (The Alan Guttmacher Institute, 1990b). The figures include 42,000 admissions for follicular cysts (*ICD-9* 620.0), 15,000 for lutein cysts (*ICD-9* 620.1) and 121,000 for ovarian cysts not otherwise specified (*ICD-9* 620.2); they exclude benign neoplasm of ovary (*ICD-9* 220), anomalies of ovaries (*ICD-9* 752.0) and polycystic ovaries, including Stein-Leventhal syndrome (*ICD-9* 256.4). Our estimates are markedly higher than those of Ory et al. (1983). The latter investigators based their calculations on data from the Boston Collaborative Drug Surveillance Programme. The difference between the earlier estimates and ours may be due to variations in the rate of hospitalization for these conditions over time, to differences between the Boston area and the rest of the United States, to a fundamental difference in definitions of a hospital admission event between the two sets of data or to increased detection of ovarian cysts due to changes in medical technology and practice.

Hospital admissions for benign breast disease—Calculated by applying age-specific rates from the Boston Collaborative Drug Surveillance Program (1973) to the 1988 age distribution of women in the U.S. population (Hollmann, 1990). This condition is affected only by use of hormonal methods. Apparent increases in risk among women using other methods are due to the inclusion of pill users in the comparison group. We assumed a relative risk of 0.5 for current use of combined oral contraceptives (Brinton et al., 1981; Stadel and Schlesselman, 1986). Hospital admissions totaled over 24,000 in 1987, or 42 per 100,000 women aged 15–44 (The Alan Guttmacher Institute, 1990b); our estimates are considerably lower than those of Ory et al. (1983). Presumably the difference is due to an increase over the past decade in the tendency to manage benign breast disease on an outpatient basis.

Hospital admissions for uterine perforation—Occurs among IUD users only. We used the same estimate as Ory et al. (1983) of 40 perforations per 100,000 IUD insertions.

Hospital admissions for complications of tubal sterilization—Based on a review of several large-scale studies (Ross et al., 1985) showing that per 100,000 tubal sterilizations, the number involving complications requiring hospitalization ranges from 800 to 2,000, depending on the type of procedure performed; we used an estimate of 1,400 per 100,000.

Hospital admissions for complications of vasectomy—Peterson et al., 1990; Ross et al., 1985.

CHAPTER THIRTEEN

13.1 National Center for Health Statistics, 1990.

In 1987, the reported numbers of deaths from various causes per 100,000 women, by five-year age-group (15–19 through 40–44), were as follows: **pregnancy and childbirth**—0.3, 0.5, 0.6, 0.6, 0.3 and 0.1 (numbers shown in Figure 13.1 are inflated by 33 percent to account for underreporting [Rochat et al., 1988]); **homicide**—4.4, 7.4, 7.5, 6.4, 5.2 and 4.3; **suicide**—4.2, 4.4, 5.4, 6.5, 6.7 and 7.8; **accidents**—25.0, 21.4, 17.7, 14.9, 14.6 and 14.4; **other causes**—6.4, 13.0, 18.5, 27.4, 35.6 and 44.4; **cardiovascular diseases**—2.1, 3.6, 6.3, 10.0, 17.2 and 33.2; **cancer**—3.7, 4.5, 8.4, 17.2, 35.0 and 63.1.

13.2 Deaths per 100,000 ectopic pregnancies—Estimates are based on Lawson et al. (1989). We assumed that the ratios of the age-specific mortality rates to the overall rate at ages 15–44 reported for 1970–1986 also applied to 1986, when the overall mortality rate was 49 per 100,000 ectopic pregnancies.

Deaths per 100,000 live births—We inflated the mortality rates reported in National Center for Health Statistics (1990) by 33 percent

to adjust for underreporting, as suggested by Rochat et al. (1988).

Deaths per 100,000 induced abortions—We assumed that the ratios of the age-specific mortality rates to the overall rate at ages 15–44 in 1981–1985 (S. K. Henshaw, personal communication, 1989) also applied to 1985, when the overall mortality rate was 0.4 per 100,000 induced abortions (Gold, 1990). For age-groups 35–39 and 40–44, we based our estimates on data for all women aged 35–44.

13.3 To obtain estimates for this figure, we ran SMLTREE models (see appendix A) for all women aged 15–44 and assumed that pregnancy, or failure, rates were low; that the risk of upper genital tract infection was low; and that no women were infertile at the beginning of the simulation. We ran two separate models for each method, using two assumptions regarding all nonectopic pregnancies that did not end in spontaneous abortions: (1) They were all carried to term, and (2) they all ended in induced abortions.

We applied the following mortality rates to the annual numbers of events that we estimated using SMLTREE: **ectopic pregnancies**—49 deaths per 100,000 (Lawson et al., 1989); **live births**—eight deaths per 100,000 (National Center for Health Statistics, 1990, inflated by 33 percent as suggested by Rochat et al., 1988); **induced abortions**—0.4 deaths per 100,000 (Gold, 1990); **spontaneous abortions**—1.5 deaths per 100,000 (derived from the number of deaths from spontaneous abortion reported in National Center for Health Statistics (1990) and from estimates of the number of spontaneous abortions in the United States [S. K. Henshaw, personal communication, 1989]); **upper genital tract infection**—three per 100,000 (estimated arbitrarily); **trophoblastic disease**—we calculated the number of cases of trophoblastic disease needing chemotherapy and the number of cases of choriocarcinoma as follows: We first obtained the total number of pregnancies for each method and for nonuse from SMLTREE. We then assumed that one per 1,000 of these pregnancies would be a molar pregnancy (Bracken, 1988; Atrash et al., 1986; Cohen et al., 1979; Kiel, 1986). Of these molar pregnancies, we assumed that 15 percent would require chemotherapy (Curry et al., 1989; Berkowitz and Goldstein, 1988). We then added additional cases of trophoblastic disease that would not be associated with molar pregnancies (choricarcinoma) at a rate of 2.5 per 100,000 pregnancies (Lederman et al., 1987). Finally, we arbitrarily assumed that mortality would be one percent of the estimated number of cases of trophoblastic disease needing chemotherapy and choriocarcinomas.

A value of zero in this figure indicates that the estimate is less than 0.1 per 100,000. The rates for long-acting hormonal methods are the unweighted averages of estimates for NORPLANT and Depo-Provera.

13.4 We estimated pregnancy-related mortality as described in the note to Figure 13.3, with the following differences: We ran separate SMLTREE models for each five-year age-group (15–19 through 40–44), assuming that at the beginning of each simulation, a proportion of women had experienced at least one episode of upper genital tract infection (see appendix A for these proportions). All estimates for contraceptive users shown in this figure assume that all nonectopic pregnancies that do not end in spontaneous abortions are carried to term.

We used the estimates shown in Figure 13.2 for age-specific mortality rates for ectopic pregnancies, induced abortions and live births. The numbers of deaths per 100,000 spontaneous abortions, by five-year age-group (15–19 through 40–44), were, respectively, 1.1, 1.2, 1.2, 1.7, 3.6 and 8.0. We estimated these rates from the overall rate of 1.5 per 100,000 (see note to Figure 13.3), by assuming that the ratio of age-specific mortality rates to the overall rate is the same as that for mortality rates for live births. We assumed the estimated mortality rates for trophoblastic disease (one percent of cases needing chemo-therapy and choriocarcinomas) and for upper genital tract infection (three per 100,000 cases) do not vary with age (see note to Figure 13.3).

Figure 13.4 shows pregnancy-related and method-related deaths for hormonal methods and sterilization only.

The number of deaths per 100,000 women due to pregnancy and childbirth and the number of deaths due to the method, by age-group, are:

Age-group and method	Deaths due to:	
	Pregnancy and childbirth	Method
15–19		
Oral contraceptives	0.4	0.4
Long-acting hormonals	0.0	0.2
Tubal sterilization	0.3	1.0
Vasectomy	0.0	0.1*
20–24		
Oral contraceptives	0.3	1.0
Long-acting hormonals	0.0	0.6
Tubal sterilization	0.2	1.0
Vasectomy	0.0	0.1*
25–29		
Oral contraceptives	0.2	0.9
Long-acting hormonals	0.0	0.5
Tubal sterilization	0.1	1.0
Vasectomy	0.0	0.1*
30–34		
Oral contraceptives	0.2	1.6
Long-acting hormonals	0.0	0.8
Tubal sterilization	0.1	1.0
Vasectomy	0.0	0.1*
35–39		
Oral contraceptives	0.3	0.7
Long-acting hormonals	0.1	0.4
Tubal sterilization	0.2	1.0
Vasectomy	0.0	0.1*
40–44		
Oral contraceptives	0.6	1.3
Long-acting hormonals	0.1	0.5
Tubal sterilization	0.3	1.0
Vasectomy	0.1	0.1*

*Per 100,000 men.

Method-related mortality for oral contraceptive users is the additional mortality from cardiovascular disease that women using the pill would experience compared with nonusers; these estimates are described in chapter 11 and in the note to Figures 12.1–12.6. We assumed that among pill users aged 15–24, the proportions who smoke not at all, lightly and heavily are those reported by Goldbaum et al. (1987); that no pill users aged 25–34 smoke heavily and that the proportions who smoke not at all and lightly are those reported in Goldbaum et al.; and that none of those aged 35–44 smoke at all.

Method-related mortality for women using long-acting hormonal methods is the additional mortality from cardiovascular disease that women using hormonal methods would experience compared with nonusers. We assumed, arbitrarily, that these methods would entail no raised risk of myocardial infarction, nonhemorrhagic stroke or venous thrombosis and embolism, but that the risk of subarachnoid hemorrhage would be the same as that for users of combined oral contraceptives (i.e., a relative risk of 2.0 compared with users of nonhormonal methods). Assumptions regarding smoking among users and nonusers are the same as those made for oral contraceptives.

Method-related mortality for sterilization represents one-time risks to the woman or man at the time of the procedure. The estimates used—one per 100,000 tubal sterilizations and 0.1 per 100,000 vasectomies—are rough ones (see notes 235 and 236 to text).

13.5 Deaths averted during current method use—The number of deaths averted per 100,000 women using oral contraceptives or barrier or spermicide methods is taken directly from Figure 13.4 as the difference between the number among women using no method and choosing birth and the number among oral contraceptive users or those using barrier or spermicide methods (we assumed all contraceptive users choose births). For those using barrier or spermicide methods, we used an unweighted average of the rates shown in Figure 13.4 for these methods (i.e., condom, diaphragm/cap, sponge and spermicides).

Future deaths averted by ever-use—The figure shows, for each five-year age-group, the estimated number of deaths from cancer diagnosed before age 45 that are averted as a result of ever-use of oral contraceptives or of barrier or spermicide methods. We assumed the number of deaths averted equals the estimated number of cancers lethal within five years that are averted, calculated using the methodology and assumptions presented in chapter 10. We estimated that ever having used barrier or spermicide methods reduces the risk of cervical cancer by 50 percent across all age-groups. Ever having used oral contraceptives has no effect on the risk of cervical cancer, but is associated with a 40 percent reduction in the risk of ovarian cancer, a 50 percent reduction in endometrial cancer and a 150 percent increase in liver cancer in each age-group; ever-use of oral contraceptives was assumed to increase the risk of breast cancer diagnosis before age 45 by 90 percent among women aged 15–34 and by 10 percent among those 35–44. We calculated the total number of cancers lethal within five years that are averted before age 45 as the difference between the number estimated among 100,000 women who had ever used barrier or spermicide methods, or oral contraceptives, and 100,000 women who never used the method, cumulating the difference between ever-users and never-users in each successive age-group, beginning at the midpoint of each age-group.

APPENDIX A

The Simulation Models

We obtained the estimates of the incidence of various events used throughout this book by modeling the reproductive experiences of hypothetical cohorts of 100,000 women using different contraceptive methods. The model we developed provides estimates of such events as pregnancy, live birth, spontaneous abortion, ectopic pregnancy, episodes of upper genital tract infection, infertility resulting from ectopic pregnancy and infertility resulting from upper genital tract infection.

Our models permit us to calculate the number of events that would be expected to occur in a specified time period, given a set of probabilities for each event. The purpose of this modeling effort is to demonstrate what the differences across methods in the probabilities of specific risks imply for health outcomes among groups of users. These models were developed using an advanced version of the SMLTREE decision tree analysis program written by Hollenberg (1989).

The models simulate the reproductive experience of a population of women on a month-to-month basis by using estimates of the probability of each event's occurring in a given month. For example, at the start of the simulation, all 100,000 women are assumed to be nonpregnant, fecund and sexually active. In the first month of the simulation process, all women are subject to specific risks of conception and of developing upper genital tract infections. (These models do not include estimates for lower genital tract infection.) Thus, in the second month, some proportion of women will be pregnant, some will have an upper genital tract infection and the remainder will continue to be exposed to the risk of conception and infection.

As the simulation proceeds, the women who become pregnant are divided into those who have an ectopic pregnancy, those who have a spontaneous abortion, and those whose pregnancy continues to a live birth, according to specific probabilities of those outcomes of pregnancy. Once categorized in this way, all of the pregnant women spend a number of months not exposed to the risk of pregnancy or upper genital tract infection. For example, a woman having a live birth will be pregnant for nine months and postpartum for three months, during which time we assume she is not at risk of conception or infection. Thus, if she becomes pregnant in the first month of the simulation process, she will return to the risk of conception and infection in the 13th month of the process.

We ran the models separately for each method and for nonuse. Each of these models was run twice—once assuming all pregnancies that were not ectopic and not spontaneously aborted ended in a birth and once in which these pregnancies were assumed to end with an induced abortion. We included probabilities of upper genital tract infections following births and abortions, both spontaneous and induced, during the month of pregnancy resolution. These episodes, like upper genital tract infections not related to pregnancy, contribute to the risk of subsequent infertility.

The SMLTREE program provides an elaborate tree that allows us to vary the risks of ectopic pregnancy and infertility according to the events a woman has already experienced. For example, women who have had one episode of pelvic inflammatory disease (PID) or a pregnancy-related infection are at a higher risk of ectopic pregnancy than women who have never had an upper genital tract infection. Therefore, women who have an upper genital tract infection during the simulation process will subsequently have an increased risk of ectopic pregnancy (if they become pregnant) for the remainder of the simulation process.

The risk of ectopic pregnancy and infertility increases after each episode of ectopic pregnancy and each episode of upper genital tract infection for up to three episodes of each event; subsequently, the risk remains the same.

In these models, all states, or events, have waiting times during which the women are not subject to the risk of other events. Some states have a defined length of time, but for others, the duration can vary. For example, the amount of time a woman spends in the fecund, nonpregnant state depends on the probabilities of encountering an event (such as pregnancy or infection). On the other hand, women who have an ectopic pregnancy, spontaneous abortion or induced abortion spend three months in a waiting state during those events. Women who have an episode of PID or a pregnancy-related infection spend one month in a waiting state.

Not only are we able to count the number of events that occur during the five-year time frame, but we can see how the population of women is distributed across all states at the end of the five years. For example, some proportion of women are in their fifth month of pregnancy, and some are at risk of conception. We used this distribution to estimate the average annual distribution for the specific group of method users under consideration. We used this five-year distribution both because the distribution after only one year is greatly affected by the starting assumption that all women entering the model are not pregnant, and because the distribution after five years, although somewhat arbitrarily chosen, allows enough time for the population to experience the various risks and is more likely to represent the experiences a group of women might have than a simulation run for a longer period of time. By contrast, a steady-state distribution would take far more than 30 years—the length of many women's reproductive lives—to attain and would not be an appropriate representation of the experience most women would have.

We ran each model separately for all women aged 15–44 and, to produce age-specific estimates, we ran separate models for each five-year age-group (i.e., 15–19, 20–24, 25–29, 30–34, 35–39 and 40–44). In the models for all women 15–44, we assumed that all women had no known sterility (since almost all women initiating contraceptive use believe themselves to be at risk of pregnancy) and had never had an ectopic pregnancy or upper genital tract infection at the beginning of the modeling procedure. In the age-specific models, we assumed that a proportion of the women in each of the age-groups from 20–24 to 40–44 would have already had at least one episode of upper genital tract infection. Therefore, the simulation process for each age-group began with a proportion of women characterized as having a history of upper genital tract infection. The proportions used are the cumulative age-specific estimates of U.S. women who have had at least one episode of PID as follows: 0 percent at ages 15–19; 7.2 percent at ages 20–24; 15.2 percent at ages 25–29; 21.7 percent at ages 30–34; 27.2 percent at ages 35–39; and 30.4 percent at ages 40–44.[1]

Monthly probabilities of the various events included in the models were calculated from annual risks. The probabilities of pregnancy are discussed in appendix B and calculations for the probability of spontaneous abortion are discussed below. Monthly probabilities of other events were calculated from the annual risks described in this book and the probabilities of each event varied depending on the method for which the model was run, according to the information presented in the following chapters: PID—chapter 7; upper genital tract infection associated with birth and spontaneous and induced abortion—chapter 7; ectopic pregnancy following zero, one, two and three or more previous episodes of upper genital tract infection—chapter 8; ectopic pregnancy following zero, one, two and three or more previous ectopic pregnancies—chapter 8; tubal infertility following one, two and three or more episodes of upper genital tract infection—chapter 9; tubal infertility following one, two and three or more episodes of ectopic pregnancy—chapter 9.

Spontaneous Abortion

Available estimates of the proportion of pregnancies that end in a spontaneous abortion range from about eight percent to 30 percent, depending upon the characteristics of the women studied and upon the technology available to detect losses that would otherwise go unnoticed.[2] In our models, we assumed that the overall probability of spontaneous abortion is 15 percent among women who do not choose abortion. We also assumed that, among women who decide to terminate a pregnancy, 10 percent will have a spontaneous abortion before the induced abortion occurs, since some conceptions that are terminated by early induced abortion would have ended in spontaneous abortion slightly later in the pregnancy.[3]

We estimated age-specific spontaneous abortion rates by applying age differentials provided by Italian vital registration data to the overall rate of 15 percent for women choosing to have a birth (and to 10 percent for women choosing induced abortion).[4] The resulting estimates of age-specific spontaneous abortion rates are as follows: 12.7 percent for women 15–19, 11.9 percent for those 20–24, 12.4 percent for those 25–29, 15.8 percent for those 30–34, 23.0 percent for those 35–39 and 41.9 percent for those 40–44. For women who decide to have an induced abortion, the spontaneous abortion rates for the five-year age-groups are 8.5 percent, 7.9 percent, 8.3 percent, 10.5 percent, 15.3 percent and 27.9 percent, respectively.

For model calculations, we assumed that a spontaneous abortion is twice as likely to occur if a woman becomes pregnant while using an IUD, regardless of her age.[5] No available evidence demonstrates an increased likelihood of spontaneous abortion with the use of any of the other methods discussed in this book.

In all SMLTREE models, we do not include progestin-only oral contraceptives or progestin IUDs because there are no reliable estimates of their effects on the risk of upper genital tract infection and because few American women use them.[6]

APPENDIX B

Contraceptive Failure Rates

At the individual level, any particular woman or couple either does or does not conceive in a year's time. Pregnancy rates used in this book reflect the experience of large numbers of women, however, some of whom will and some of whom will not become pregnant. Any individual woman increases her chance of being in the group that does not become pregnant by picking a method with a low risk of pregnancy and using that method consistently and correctly. For some methods, rates under conditions of perfect (i.e., correct and consistent) use and actual use are very similar or the same, indicating that how well the method is used has little impact on the pregnancy rates.[7]

Trussell et al. (1990) have estimated failure rates under conditions of perfect use (Table B.1, column 1) and of typical use. Other estimates of failure rates of typical or average use were calculated by Jones and Forrest (1989) and include adjustments for the fact that many pregnancies following contraceptive failure and ending in abortion were not reported in the survey from which the failure rates were calculated. Jones and Forrest present abortion-adjusted failure rates for periodic abstinence, the condom, the diaphragm, spermicides and oral contraceptives that are standardized to take into account differences among users of each method in age, race and marital status (Table B.1, column 2).

Unfortunately, abortion-adjusted estimates for many methods are not available from the Jones and Forrest study. We have therefore inflated the failure rates for withdrawal, the IUD, injectables, implants and sterilization presented for typical users in Trussell et al. (1990) by a constant value (34.3 percent) (Table B.1, column 2). This value is the average percentage by which the standardized failure rates increased once unreported abortions were taken into account for the methods Jones and Forrest were able to estimate from the 1982 National Survey of Family Growth (NSFG).

There are no available estimates of failure rates for the cervical cap or sponge from retrospective surveys such as the NSFG. Following the logic used by Trussell et al. (1990), we assumed that the pregnancy rates for users of the cap and for nulliparous sponge users are roughly equivalent to that for diaphragm users. Trussell et al. give rates separately for parous and nulliparous women using the sponge. We estimated one rate on the basis of the proportion of sponge users who are parous and nulliparous (Table B.1, column 2). However, we did not inflate the rate for parous sponge users to account for unreported abortions. Good evidence supports the idea that the failure rate for the sponge is considerably higher among parous users than among nulliparous users,[8] but precisely how much higher is still unknown.

The failure rate we use for no method is also not adjusted for unreported abortions, since it is not estimated from a population-based survey.

TABLE B.1

Estimated percentage of women experiencing an unintended pregnancy in the first year of use, by contraceptive method and type of use.

Method	Perfect use	Average use (perfect and imperfect use)
No method (chance)	85.0	85.0
Periodic abstinence*	9.0	19.0
Withdrawal	4.0	24.0
Condom	2.0	16.0
Diaphragm	6.0	18.0
Cap	6.0	18.0
Sponge†	8.0	24.0
Spermicides	3.0	30.0
IUD‡	0.8	4.0
Oral Contraceptives§	0.1	6.0
Implants**	0.04	0.05
Injectables††	0.3	0.4
Tubal sterilization	0.2	0.5
Vasectomy	0.1	0.2

*Perfect-use rate is for the calendar method, the periodic abstinence regime most commonly used in the United States; perfect-use rates for postovulation, symptothermal and ovulation method regimes are 1–3 percent.

†Perfect-use and average-use rates for parous women are nine percent and 28 percent, respectively; for nulliparous women, six percent and 18 percent, respectively. The average-use rate assumes 59 percent of users are parous, the proportion reported in the 1988 National Survey of Family Growth (The Alan Guttmacher Institute, 1990a).

‡Perfect-use rate is for the copper IUD; rate for the progestin IUD is two percent. Average-use rate is assumed to be the same for both.

§Perfect-use rate is for combined pill; rate for progestin-only pill is 0.5 percent. Average-use rate is based on all pill users; almost all U.S. pill users use combined pills (Forrest, 1990).

**Perfect-use rate for six-rod NORPLANT; rate for two-rod is 0.03 percent. Average-use rate for two-rod is 0.04 percent.

††Perfect-use rate is for Depro-Provera; rate for NET is 0.4 percent. Average-use rate for NET is 0.5 percent.

Source: Perfect-use rates—Trussell et al., 1990. Average-use rates—calculated from Jones and Forrest, 1989; Trussell et al., 1990; and Grady et al., 1986.

We took this estimate directly from Trussell et al. (1990), as an estimate of the proportion of women who, if they did not use contraceptives, would become pregnant within a year.[9]

The set of abortion-adjusted failure rates we estimated for typical users aged 15–44 (referred to here as average-use rates) are shown in Table B.1 (column 2). Throughout this book, however, we use low, rather than average, estimates of typical-use contraceptive failure. The following sections explain how these low (and high) estimates were obtained for each age-group and for all women aged 15–44.

Age-Specific Failure Rates: Lowest and Highest Estimates

The lowest failure rates for any contraceptive result from perfect use of the method. However, perfect-use failure rates are not readily observable. For the purpose of modeling the contraceptive experience U.S. women might actually have, we chose to use estimates of the lowest and highest pregnancy rates among race and marital status subgroups of women in each age-group. These rates reflect the actual unintended pregnancy experience of contraceptive users. The groups with the lowest rates are likely to include a greater proportion of women who use the method both consistently and correctly than groups with high rates.

Age-specific rates for five of the 13 methods of interest—spermicides, periodic abstinence, the diaphragm, the condom and the pill—are from Jones and Forrest (1989). These rates are presented in Table B.2.

For the cap and the sponge, again we followed Trussell et al. (1990), who reason that pregnancy rates among cap users and nulliparous sponge users are likely to be similar to those among diaphragm users. Therefore, we assigned the age-specific rates we used for the diaphragm to the cap, and inflated the diaphragm rates by 33 percent to obtain rates for the sponge. The inflation factor is the ratio of the sponge failure rate to the diaphragm rate (from Table B.1, column 2).

We assumed that the patterns of age-specific pregnancy rates among users of withdrawal are likely to be similar to those among condom users. We therefore inflated the age-specific rates for the condom by 1.5 to obtain age-specific rates for withdrawal. The inflation factor is the ratio of the withdrawal failure rate to the condom failure rate (from Table B.1, column 2).

For the IUD, we obtained age-specific failure rates from Grady et al. (1986). Grady and his colleagues present rates by pregnancy intention (prevent vs. delay) and age-group (under 20, 20–24, 25–29 and 30–44), standardized for income and parity. For the lowest rate in each age-group, we used the pregnancy rate among preventers in that age-group; for the highest, we used the rate among delayers. We deflated each of these estimates by the ratio of Grady et al.'s abortion-adjusted rate (6.0) to the IUD failure rate in Table B.1 (4.0).[10]

For injectable progestins and female and male sterilization, we made the simplifying assumption that contraceptive failure rates do not vary by user's age and used the rates for average use shown in Table B.1. For implants, we

TABLE B.2

Estimates of lowest and highest age-specific failure rates

No method		Average
Total	*15–44*	*85*
	15–19	90
	20–24	95
	25–29	90
	30–34	85
	35–39	80
	40–44	70

Periodic abstinence		Lowest	Highest
Total	*15–44*	*13.8*	*19.2*
	15–19	25.1	34.1
	20–24	21.1	28.9
	25–29	12.2	17.2
	30–34	12.2	17.2
	35–39	6.2	8.9
	40–44	6.2	8.9

Withdrawal		Lowest	Highest
Total	*15–44*	*14.7*	*27.8*
	15–19	17.1	29.0
	20–24	29.1	54.5
	25–29	15.9	31.4
	30–34	15.9	31.4
	35–39	5.0	10.2
	40–44	5.0	10.2

Condom		Lowest	Highest
Total	*15–44*	*9.8*	*18.5*
	15–19	11.4	19.3
	20–24	19.4	36.3
	25–29	10.6	20.9
	30–34	10.6	20.9
	35–39	3.3	6.8
	40–44	3.3	6.8

Diaphragm/cap		Lowest	Highest
Total	*15–44*	*12.0*	*38.9*
	15–19	10.6	35.5
	20–24	19.4	57.0
	25–29	10.7	35.8
	30–34	10.7	35.8
	35–39	10.3	34.7
	40–44	10.3	34.7

Sponge		Lowest	Highest
Total	*15–44*	*16.0*	*51.9*
	15–19	14.1	47.3
	20–24	25.9	76.0
	25–29	14.3	47.7
	30–34	14.3	47.7
	35–39	13.7	46.3
	40–44	13.7	46.3

Spermicides		Lowest	Highest
Total	*15–44*	*21.6*	*25.6*
	15–19	29.7	35.0
	20–24	33.0	38.7
	25–29	24.3	28.8
	30–34	24.3	28.8
	35–39	9.1	11.0
	40–44	9.1	11.0

IUD		Lowest	Highest
Total	*15–44*	*2.5*	*4.5*
	15–19	2.2	6.3
	20–24	4.6	5.1
	25–29	3.3	3.8
	30–34	1.7	3.9
	35–39	1.7	3.9
	40–44	1.7	3.9

Oral contraceptives		Lowest	Highest
Total	*15–44*	*3.8*	*8.7*
	15–19	8.0	18.1
	20–24	5.0	11.7
	25–29	2.9	6.7
	30–34	2.9	6.7
	35–39	1.9	4.5
	40–44	1.9	4.5

Implants		Lowest	Highest
Total	*15–44*	*0.05*	*0.5*

	Average*
Injectables	0.4
Tubal sterilization	0.5
Vasectomy	0.2

*Average-use rates from Table B.1; rate for women 15–44, no variation by age or consistency and correctness of use.

assumed that the low and high estimates do not vary by age. Both estimates are obtained from the rates for average use (Table B.1, column 2), but the high estimate reflects recent evidence that failures are more likely to occur as the body weight of the user increases.[11]

The age-specific failure rates for no method are simply our best guess of the proportion of women who would become pregnant within one year of exposure to the risk of pregnancy if they did not practice contraception. We based this guess in part on age-specific findings from Mosher (1982), who calculated the proportion of couples who had been continuously married that had not used a contraceptive method and had not conceived during the 12 months prior to the time of the survey interview (from the 1976 National Survey of Family Growth). For the youngest age-group we used a substantially lower estimate than Mosher's for all women, whether married or not, since other investigators have pointed to the greater likelihood of anovulatory cycles among the youngest women.[12]

In Table B.2, we present failure rates for six five-year age-groups: 15–19, 20–24, 25–29, 30–34, 35–39 and 40–44. However, the age-specific rates available from the 1982 NSFG were for four age-groups: under 20, 20–24, 25–34 and 35 or older. We applied the rates for the group 25–34 to both five-year age-groups contained in it (25–29 and 30–34). Similarly, we assumed that the rates for age-groups 35–39 and 40–44 are equivalent, and assigned both the rate for the category 35 or older. Grady et al. (1986) provide one rate for the age-group 30–44. Therefore, for the IUD only, we used the same rate—that for ages 30–44—for each of the last three age-groups (30–34, 35–39 and 40–44).

Overall Failure Rates (Women Aged 15–44): Lowest and Highest Estimates

To obtain a lowest overall pregnancy rate for all women aged 15–44, we took the simple arithmetic average of the lowest rates across age-groups for each method, and likewise for the highest overall rate. A method's lowest failure rate calculated in this way should not be confused with the lowest expected, or perfect-use, failure rates presented by Trussell et al. (1990). The latter are considerably lower than the lowest failure rates presented here; perfect-use failure rates indicate that couples who use *any* method carefully and consistently should be relatively successful at avoiding pregnancy. Our lowest-rate subgroups are not made up solely of perfect users, or even of a majority of perfect users. Rather, we present rough estimates of the lowest average-use rates, adjusted upward to account for unreported abortions. Our estimates of the highest failure rates probably reflect higher proportions of couples who use the method very imperfectly. These overall rates, applied in most of our models, appear in Table B.2.

1 Rates of PID per 100,000 women in five-year age-groups (15–19 through 40–44) for 1987 are based on unpublished tabulations from the 1987 National Hospital Discharge Survey, multiplied by four to obtain estimates of the rates of all PID episodes—ambulatory plus hospital admissions (E. Galaid, personal communication, 1990). We divided these rates by the proportion in each age-group who have ever had intercourse, as given in the 1988 National Survey of Family Growth (Forrest and Singh, 1990).

2 Mills et al., 1988; Pérez and Gray, 1988; Roetzer, 1988; Wilcox et al., 1988; Narod and Khazen, 1989; Regan et al., 1989; Bongaarts and Potter, 1983.

3 Potter et al., 1975.

4 Figa'-Talamanca and Repetto, 1988.

5 Harlap et al., 1980; Foreman et al., 1981; Skjeldestad et al., 1988.

6 Mosher, 1990; Forrest, 1990.

7 Trussell and Kost, 1987.

8 "Today sponge effectiveness data . . . ," 1989.

9 In the 1982 National Survey of Family Growth, the observed proportions becoming pregnant among women who used no method and who did not intend to become pregnant were far lower (about 40 percent overall) than our estimates; however, there is little doubt that women using no method in the National Survey of Family Growth were selected for lower fecundity, lower coital frequency or both. Thus, the failure rates we present for no method are somewhat hypothetical and are intended to represent the first-year pregnancy rates of women if they were simply to rely on chance rather than on a method of contraception.

10 The Grady et al. rate is for currently married women and is standardized for a different set of variables than those presented in Table B.1.

11 I. Sivin, personal communication, 1990.

12 Bongaarts and Potter, 1983.

Alan Guttmacher Institute, The. Unpublished tabulations from the 1988 National Survey of Family Growth, 1990a.

Alan Guttmacher Institute, The. Unpublished tabulations from the 1987 National Hospital Discharge Survey, 1990b.

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Errata

Preventing Pregnancy, Protecting Health: A New Look at Birth Control Choices in the United States

On page 33 (text) and page 34 (Figure 5.2), the percentages of unintended pregnancies among nonusers and users are reversed. Among nonusers of contraceptives, the percentages of unintended pregnancies ending in birth, induced abortion and spontaneous abortion should be 46.3, 41.0 and 12.7, respectively. Among users, the percentages should be 40.1, 47.5 and 12.4, respectively.

On page 114, middle column, first full paragraph (Note to Figure 7.2), the first sentence should read, "For nonusers, we estimated the monthly baseline risk of PID to be 174.0 per 100,000 women." The third sentence should read, "The monthly rate we calculated among nonusers of contraceptives (17.4 per 100,000) is higher than the annual rate of 14.0 per 100,000 nonusers of the IUD observed by Vessey et al. (1981) . . . ."